

Durham E-Theses

Can Science Investigate the Supernatural? An investigation into the relationship between science, the supernatural and religion.

WINTHROP, JONATHAN,PETER

How to cite:

WINTHROP, JONATHAN,PETER (2016) *Can Science Investigate the Supernatural? An investigation into the relationship between science, the supernatural and religion.*, Durham theses, Durham University. Available at Durham E-Theses Online: <http://etheses.dur.ac.uk/11763/>

Use policy

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in Durham E-Theses
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full Durham E-Theses policy](#) for further details.

Academic Support Office, Durham University, University Office, Old Elvet, Durham DH1 3HP
e-mail: e-theses.admin@dur.ac.uk Tel: +44 0191 334 6107
<http://etheses.dur.ac.uk>

Can Science Investigate the Supernatural?

An investigation into the relationship between science, the supernatural, and religion.

Jonathan Peter Winthrop

Abstract

Throughout the last century there has been much discussion over what it is that makes an activity or a theory 'scientific'. In the philosophy of science, conversation has focused on differentiating legitimate science from so-called 'pseudoscience'. In the broader cultural sphere this topic has received attention in multiple legal debates regarding the status of creationism, where it has been generally agreed that the 'supernatural' nature of the claims involved renders them unscientific.

In this thesis I focus upon the latter of these issues, arguing that although there may be merit in the larger demarcation project of separating science from pseudoscience, the notion of 'supernaturality' does not belong in this adjudication. Due to the complex cultural issues that have played a role in the history of this topic, this will involve a degree of historical and normative analysis alongside more philosophically abstract considerations.

Complicating the discussion is the fact that neither the term 'science' nor 'supernatural' enjoys a widely agreed upon definition. In order to assess the question then, I will survey a wide variety of definitions of each term in order to identify areas of potential conflict. I argue that in none of the prevalent understandings can we find impediment to scientific investigation inherent in the supernaturality of a claim, but rather posit that where difficulty arises it does so for more mundane reasons.

I conclude that not only is there no inherent issue with scientific investigation of the supernatural, but that the term 'supernatural' itself is too poorly defined to provide a useful role in philosophical discussion. While I argue that notions of supernaturality should be abandoned entirely when assessing demarcation criteria, I concede that numerous extraneous factors, including the significant degree of overlap between the supernatural and the 'religious', warrant consideration of a compromise position.

Can Science Investigate the Supernatural?

An investigation into the relationship between science, the
supernatural, and religion.

by

Jonathan Peter Winthrop

*Submitted in accordance with the requirements for the degree of Doctor of
Philosophy.*

Department of Philosophy

Durham University

2016

INTRODUCTION.....	1
-------------------	---

CHAPTER 1

AN OVERVIEW OF THE DEBATE BETWEEN SCIENCE AND THE SUPERNATURAL TODAY.....	3
---	---

FOUR POSITIONS	6
SOME PRELIMINARY ISSUES	8
PRO-SUPERNATURALIST, ANTI-SEPARATIONISTS	10
<i>A brief history of creationism</i>	10
<i>The normative aspect of the debate</i>	22
ANTI-SUPERNATURALIST, PRO-SEPARATIONISTS	24
<i>Ruse and nonoverlapping magisteria</i>	24
<i>Nonoverlapping magisteria</i>	25
PRO-SUPERNATURALIST, PRO-SEPARATIONISTS	27
<i>Don't poke the bear</i>	27
ANTI-SUPERNATURALIST, ANTI-SEPARATIONISTS.....	30
<i>Where Dawkins and Intelligent Design agree</i>	30
CONCLUSION.....	34

CHAPTER 2

DEFINING SCIENCE	36
------------------------	----

WHAT IS SCIENCE?	37
<i>Intuition and pseudoscience</i>	37
THE CONTENT OF SCIENTIFIC THEORY	43
<i>Natural Law</i>	44
<i>The natural world</i>	45
<i>Mathematics</i>	51
THE METHODOLOGY OF SCIENCE.....	52
<i>Testability</i>	53
<i>Explanation and prediction</i>	58
<i>Methodological naturalism and explanation</i>	60
<i>Anti-realist approaches to science and the supernatural</i>	63
<i>Tentativeness and Integrity</i>	67
SCIENCE AND SOCIAL STRUCTURE.....	72
CONCLUSION.....	77

CHAPTER 3

DEFINING THE SUPERNATURAL.....	79
--------------------------------	----

WHAT IS THE SUPERNATURAL?	80
<i>The supernatural and the nonnatural</i>	80
<i>The supernatural as that which cannot be investigated by science</i>	82
<i>The supernatural as that which violates the laws of nature</i>	84
<i>The supernatural as non-physical</i>	85
<i>The supernatural as that which exists beyond space and time</i>	87
DIFFERENTIATING THE SUPERNATURAL FROM THE RELIGIOUS.....	88
<i>The goals of science and religion</i>	89
<i>Religious beliefs as "properly basic"</i>	92
CONCLUSION.....	95

CHAPTER 4

SCIENCE, THE SUPERNATURAL, AND VIOLATIONS OF A LAW OF NATURE	97
HUME'S 'OF MIRACLES': A HISTORICAL STARTING POINT	99
HUMEAN THEORIES OF NATURAL LAW.....	100
<i>Naive Regularity Theory</i>	101
<i>Functionalism</i>	105
<i>A systems approach</i>	109
NON-HUMEAN THEORIES.....	114
<i>Relations between universals</i>	114
<i>Tendencies accounts</i>	120
ANTI-REALISM	124
THEISTIC OBJECTIONS TO VIOLATIONS OF LAWS OF NATURE	127
CONCLUSION	131

CHAPTER 5

SCIENTIFIC METHODOLOGY AND THE SUPERNATURAL	134
A PRELIMINARY ASIDE.....	135
TESTABILITY, CONFIRMATION AND POPPERIAN FALSIFIABILITY	138
<i>Falsification and the supernatural</i>	140
<i>Alternative conceptions of the supernatural</i>	144
KUHN – PARADIGM SHIFTS AND PROBLEM SOLVING.....	149
LAKATOS AND SCIENTIFIC RESEARCH PROGRAMS	153
FEYERABEND AND PROLIFERATION.....	157
HOYNINGEN-HUENE AND SYSTEMATICITY	159
CONCLUSION	163

CHAPTER 6

THE SUPERNATURAL AS THAT WHICH IS OUTSIDE OF SPACE AND TIME	165
'OUTSIDE' OF SPACE AND TIME	167
THE KALAM COSMOLOGICAL ARGUMENT	169
THE NATURE OF THE CAUSE AND A RETURN TO DESIGN	174
MULTIVERSE THEORY AND TESTABILITY	179
FINE-TUNING ARGUMENTS	183
NATURAL ATHEOLOGY	186
THEISM UNDERPINNING SCIENCE	193
CONCLUSION	197

CHAPTER 7

OUTCOMES, LIMITATIONS, AND THE RELATIONSHIP TO DEMARCATION	199
OUTCOMES	200
<i>Primary outcome: The supernatural should not be excluded from science</i>	200
<i>Secondary outcome: The term 'supernatural' does not belong in rigorous discourse</i>	203
<i>The ghostly elephant in the room</i>	206
LIMITATIONS	210
<i>Partially Overlapping Magisteria</i>	215
RELATIONSHIP TO THE DEMARCATION DEBATE AND MOVING FORWARD	217
CONCLUSION	222

REFERENCES	224
-------------------------	------------

The copyright of this thesis rests with the author. No quotation from it should be published without the author's prior written consent and information derived from it should be acknowledged.

Acknowledgements

My sincerest gratitude to my thesis supervisor, Dr. Robin Hendry. Thank you not only for your support in writing this thesis, but for everything that you have done for me since I first enrolled as an undergraduate, more than ten years ago.

A similar thank you is extended to the staff and students of both The Department of Philosophy and Van Mildert College, though the contributions here are far too numerous and varied to mention in detail.

Finally, thank you to Ann and David, Carol and Paul, the Hill tribe, and most of all Becky. This would not have been possible without you.

Introduction

We maintain that science and religion embrace two separate and distinct fields of thought and learning. We remember that Jesus said: 'Render unto Caesar the things that are Caesar's, and unto God the things that are God's.'
– Dudley Field Malone, speaking at the Scopes trial in 1925

Over the course of the twentieth century, much philosophical discussion has attempted to address the so-called 'demarcation debate', delineating between legitimate science and 'pseudoscience'. In parallel to this discussion, and in many ways informed by it, there has been much debate in the legal and cultural spheres over the scientific status of creationism. In both of these cases it has often been determined that the supernaturality of a proposed hypothesis or phenomenon would exclude it from scientific investigation.

In this thesis I intend to argue that supernaturality should play no role in demarcation. Whilst there may be legitimate reasons to exclude creationism from science, the idea that it makes supernatural claims is not among them. I will argue that those arguing for a separationist position, either between science and the supernatural, or between science and religion, are misguided in their approach. Further, I will argue that the term 'supernatural' plays no useful role in academic discourse.

Discussion of this issue is complicated by the fact that there is little consensus over how best to define either of the terms 'science' or 'supernatural'. In order to comprehensively address this question then, it is necessary to unpack both of these concepts in a way that identifies the most prominent usages of each. With these established, we will then be able to compare their respective understandings in order to identify areas of potential conflict. Although we will encounter many such conceptions, the three that will receive the most attention address issues of natural

law, scientific method, and the supernatural understood as that which exists beyond space and time.

In every area of potential conflict, I find that no genuine incompatibility arises. In several cases the conflict itself is incoherent, such as in the many attempts to understand the concept of a 'violation' of a natural law. Even where legitimate conflict does seem to arise, this is often due to far more mundane reasons than the supernaturalism of the phenomena in question.

Finally, though I argue for the abandonment of the separationist position, I do not claim that all supernatural phenomena will be amenable to scientific investigation. Many supernaturalist claims, especially those within the domain of religion, may fall beyond the scope of science. We shall see from the very beginning of our discussion, where we discuss the complex cultural history of the debate, that the relationship between science and religion is neither fully coextensive nor one of mere mutual isolation.

Chapter 1

An overview of the debate between science and the supernatural today

In this chapter we will examine the relationships between various parties involved in the debate over science and the supernatural. The objective of this examination is primarily to contextualise the debate, as well as to highlight its importance. By discussing the various positions that thinkers have adopted, we will also have the opportunity to take note of some specific interpretations of the relationship between science and the supernatural, which will form the basis for later discussion. This chapter will thus be largely descriptive, and is intended to lay the groundwork for the critical analysis that constitutes the majority of this thesis.

In this chapter I will present a four category approach to the discussion which I believe helps us to understand the debates from both a historical and a philosophical perspective. By dividing the various thinkers in the debate according to two orthogonal criteria, namely their position on the existence of the supernatural and their position on whether or not science could investigate the supernatural (if it existed), we can get a much clearer picture of the motivations and arguments involved. More importantly, this division helps us to properly locate, and ultimately reject, attempts at finding a 'middle ground' via appeal to a separationist position between science and the supernatural.

In accordance with this objective, the chapter is organised along the four positions to be discussed. After briefly expanding upon the motivations behind this division, we shall turn our attention to the 'pro-supernatural, anti-separationist' position. This provides an opportunity to introduce one of the recurring themes of our discussion: the scientific status of creationism, particularly in the United States. As this is a key focal point of the thesis, the history of this movement, and its evolution into its modern form as 'Intelligent Design', will be given an extended introduction. This

history will largely be anchored in the various key legal decisions regarding the movement's scientific status, beginning with the famous *Scopes* trial in 1925.

Following on from *Scopes*, we shall discuss the much later case of *Epperson v. Arkansas* (1968), and its role in the move from explicitly religious 'creationism' to the purportedly scientific 'creation science'. We will then outline two cases from the 1980s: *McLean v. Arkansas* and *Edwards v. Aguillard*. The former of these decisions has particular relevance to our discussion as it introduces a legal conception of what it is to be scientific, the elements of which will serve as a partial skeleton for the structure of later discussion. Finally we shall address the 2004 *Kitzmiller v. Dover Area School District* trial, and the shift from 'creation science' to 'Intelligent Design', and briefly note some other examples of this first position.

Moving to the opposite corner of the spectrums, the second position we shall discuss is that of the 'anti-supernatural, pro-separationists'. Continuing from the creationism discussion, we shall begin with a position outlined by Michael Ruse, who contributed heavily to the decision in the *McLean* case. Following on from this, we will discuss two of the most famous articulations of a separationist position: the concepts of 'methodological naturalism' and 'non-overlapping magisteria' (NOMA).

The third group we will address is that of the 'pro-supernatural, pro-separationists'. This position is somewhat more reactionary than the other three, and is thus most easily discussed in juxtaposition with that which it opposes. We shall therefore address some of the arguments forwarded in response to claims that science has eliminated the need for a 'god hypothesis', primarily those of mathematician and Christian apologist John Lennox.

Finally, we shall look at the 'anti-supernaturalist, anti-separationist' position. In particular we will return to the arguments mentioned in section three, notably those recently forwarded by Stephen Hawking and Leonard Mlodinow. We will then, considering his cultural relevance to the debate, address some of the contributions to the discussion from Richard Dawkins.

A secondary focus of this chapter is to introduce key features of the various legal debates over creationism which have taken place in the USA. The conflicts over this particular issue highlight much of the cultural importance of this topic, as well as providing the primary motivation for conducting this investigation. All of the positions I will be discussing in this chapter have in some way been influenced by the creationist movement, and thus they can only be properly understood in light of it. In analysing the history of creationism, and the Intelligent Design movement that evolved out of it, we will be better equipped to analyse all of the perspectives in the larger debate.

The third and final objective of this chapter is to draw attention to, though not to solve, some of the normative aspects of the separationism debate. Scientific investigation, rather than being an abstract concept, is an ongoing human endeavour. It makes sense then to ask not just what science *can* investigate, but also what it *should be able to* investigate. As we shall see, much of the discussion surrounding this debate is subject to some kind of agenda as to what should, and should not, fall within scientific domain. These motivations can be religious, political, or even simply moralistic, but nevertheless they have all influenced the way that people have attempted to answer this question. Resolving this debate thus requires as much unpicking of these issues from their associated positions as it does a measured, analytical approach.

Although there will be some discussion of the legal and political normative issues surrounding this question, it is not the primary focus of this investigation. Instead, where I do make normative recommendations for scientific investigation, I will usually refer to what best reflects a way for scientists to pursue some kind of truth. Without committing myself to any specifically realist doctrine, this thesis will therefore assume that search for truth is at least a partial objective of scientific investigation. This assumption is justified by context, as the debate between creationism and naturalistic evolution, for example, only makes sense if both parties are taken to be attempting to describe the way that reality actually is. At this stage,

however, all of these topics should be considered introductory, and will receive greater attention in subsequent chapters.

Four positions

As I have suggested, it is possible to divide positions in this debate into four camps, based upon where any particular person or group stands on two importantly distinct issues. Firstly, what is their position on the primary topic of this thesis: do they consider the supernatural to be beyond the scope of scientific investigation? Secondly, and to an extent equally relevantly, what is their position regarding the existence of any particular supernatural phenomenon? It is of course possible to be agnostic regarding either of these questions, and there is also scope for gradation in the certainty with which one answers. For the most part however, at least for the purposes of this chapter, these camps can be relatively easily distinguished.

The purpose of differentiating between these four positions is threefold. In the first instance, it will elucidate our normative discussion of the debate. A thinker's metaphysical commitments frequently impact upon what they believe should be scientifically investigable and, as has been discussed, it is important to unpick such motivations in order to analyse the debate properly. Michael Ruse, for example, is strongly opposed to the claims of creationism and, as an extension of this, feels that they should be kept out of the scientific domain. In a discussion on creationism in science he offered the following remark on just how to achieve such an aim: "Popperian falsifiability may be a somewhat rough and ready way of separating science and religion, but it is good enough for the job at hand, and in law that is what counts" (2014). We will discuss the veracity of this particular claim in chapter five, but for now we can simply observe that even well intentioned participants in the debate may have chosen to sacrifice a degree of philosophical precision for what they deem to be a worthy cause.

The second objective for the differentiation is to illustrate that, in fact, one can adopt either a supernaturalistic or a naturalistic metaphysical position and still be free to support or deny the possibility of scientific investigation of the supernatural, independent of whether or not the supernatural actually exists. It will thus be argued that such motivation is inappropriate in determining one's position in the separation debate. Furthermore, by analysing the four positions, it will be demonstrated that the separation of science and the supernatural actually benefits neither the supernaturalist nor their detractors. Thus, if one is to be motivated by metaphysical commitments in the debate, then in both cases one should lean towards the inclusion of the supernatural within the scope of science.

Finally, this differentiation aims to highlight an error frequently made by proponents of separation regarding their position in the debate. To cite Michael Ruse once again, he seems to consider himself to be occupying, or at least advocating, some kind of reasoned middle ground at the centre of a one-dimensional spectrum between fundamental Christians at one end and the so-called 'New Atheists' at the other:

I have drawn the scorn both of the religious extremists – see for example the treatment of me by the journalist Ben Stein in the movie *Expelled* – and of the atheists – they contemptuously refer to people like me as "accommodationists" or (more hurtfully) as "appeasers". A middle way showing that one can accept science – real science, not science gelded to make it less threatening – and genuine religion is needed desperately. One may not convince the fanatics at the ends, but there needs to be a large place where people can perhaps disagree on ideas but nevertheless continue to respect opponents. (Ruse, 2011: 656)

By understanding these positions as a two-dimensional grid of beliefs, it will I think become clear that Ruse's position actually does not represent a middle ground at all. On the axis measuring metaphysical commitment, Ruse occupies exactly the same position as the atheists, and on the axis measuring separationist tendencies Ruse lies in opposition to both fundamentalist Christians *and* the New Atheists alike. The attempt to set up a place of respectful disagreement in between the camps, whilst a noble intent, is thus utterly misguided.

By distributing the positions as I have done, I intend to shed some light on the normative dimension of the separationist debate, as well as hopefully provide some reason for optimism regarding it. If it can be shown that one's metaphysical commitments should not bring to bear on one's attitude towards scientific methodology, then perhaps we can carve out an area of agreement between conflicting camps without having to reach a compromising middle ground position at all. We can accommodate Ruse's ideals for respectful interaction, but in a way that not only properly locates the areas of agreement, but does so for people of all metaphysical or religious persuasions.

Some preliminary issues

Before moving on to discuss the four camps in turn it is worth making a few clarifications. As noted, there is room for varying degrees of uncertainty regarding these questions, and it is hard to delineate perfectly between the camps. Individual thinkers vary in the intensity of their beliefs, and thus it is not always clear which category they fall into. Moreover, there are many occasions where a thinker's supernaturalistic tendencies have no bearing on the debate, or are not made readily clear. The issue of where a thinker stands on a particular supernatural issue will only be addressed therefore where it is felt that it has influence on their position in the larger discussion. I will also only be referencing certain thinkers in this first chapter who represent relatively extreme positions on the grid. This serves to accentuate areas of conflict and concord between camps.

Although it will not play a major role in the current chapter, which serves as an overview of the debate, there is a further distinction to be drawn within the separationist position itself. As we shall see, what I call the separationist position has been presented in various ways, though these expressions are usually blanket statements to the effect that either there is no overlap between science and religion, or that science is limited to the realm of the natural. It is worth however noting that

one may take a more nuanced approach to the topic, whereby science is declared unable to investigate supernatural hypotheses or explanations, but is able to investigate the empirical effects which these hypotheses or explanations are intended to address. For example, one might agree that science can investigate whether or not the Earth is young, or investigate the effects of intercessory prayer, but deny that science can engage in meaningful dialogue regarding if, how or why God did or did not perform such actions. We shall refer to this position as 'weak separationism'.

Complicating the issue further is the difficulty inherent in defining the term 'supernatural'. Whether or not it is sensible to use this word is a question that will occupy much of this thesis, though will not become a key point of discussion until chapter three. For the purposes of the present chapter, the supernatural will be understood in something of a colloquial sense, which is to say that ghosts, angels and miracles may be considered 'supernatural', whereas tables, birds and flowers may not. Most importantly, the God of Christian theism may be reasonably taken to possess this characteristic for the purposes of our initial discussion.

In addition to this, there is a distinction to be drawn regarding scientific discussion of the supernatural in relation to three specific terms: hypothesis, theory, and phenomenon. While there is significant overlap between discussion of these issues in the literature, as for example a discussion of creationism may feature all three, we should be careful to separate them where necessary. A supernatural hypothesis will be any hypothesis in which the entity or event being suggested is 'supernatural', for example the suggestion that a healing was the result of miraculous intervention. A supernatural phenomenon¹ shall be understood as any entity or event that is in itself supernatural, for example a miraculous healing or a ghost. A supernaturalistic theory shall be taken as any theory which makes reference to either of the former two categories.

¹ I here use the term 'phenomenon' in the colloquial sense of a situation or entity which may require explanation, rather than in the more philosophical sense regarding objects of perception.

Finally, it is important to be clear that when we describe someone as being either pro- or anti-supernatural, we are only referring to a person's stance on a specific putatively supernatural issue, rather than an entire metaphysical worldview. When I refer to Ruse, for example, as being 'anti-supernaturalist', this is only to say that he rejects the claims of creationism when it comes to the evolution debate. Similarly, where I refer to Intelligent Design proponents as being 'supernaturalist', I am not committing them to a belief in phenomena such as extrasensory perception, astrology, or ghosts. Additionally, this thesis makes no comment on whether or not supernatural phenomena actually occur. Therefore, where the investigation of a supernatural phenomenon is discussed, it should be understood in generally hypothetical terms. With that in mind, let us now turn our attention to these various positions in detail.

Pro-supernaturalist, Anti-separationists

A brief history of creationism

Let us begin our overview with one of the most prominent examples of a supernaturalist group who are opposed to the separation of science from the supernatural. Creationism, and the movements related to it, serve as an excellent example of how muddled the waters of this discussion can be, with many of its current proponents trying to disassociate their views from supernaturalism entirely. Its long and convoluted history provides many examples of how the term 'supernatural' has been understood in both philosophical and legal terms, and also offers a series of springboards for debates over the subject. Many of the viewpoints discussed in this thesis can be traced back to reactions to the controversy over creationism in the United States, and many of the facets we shall cover explicitly invoke claims made during this history.

Creationism and its modern variant, Intelligent Design theory, are an important starting point for this discussion because of the broad impact the movement has had

on society. In the USA, as well as in philosophy, creationism has had a serious impact in politics, law, and education. As we shall see throughout this section, much of the discussion centres on whether or not creationism, in any of its various forms, should be taught in schools, specifically in science classrooms. The issue goes much deeper in North American politics however. In 2014 a Gallup poll suggested that 42% of Americans believed that God created humans in their present form (Newport, 2014), and in 2008 a similar poll found that this belief was held by 60% of Republicans compared to 38% of Democrats (Newport, 2008).

Although the media coverage and legal attention is perhaps more dramatic in the United States, it would be a mistake to think that creationism is a solely North American concern. In 2008 a UK poll found that 29% of teachers at primary and secondary schools believed that creationism should be taught in school (Randerson, 2008). In 2006, another poll found that 22% of the British population thought that creationism "best described their view of the origin and development of life" and a further 17% felt the same way about Intelligent Design (BBC, 2006). We will for the most part be discussing creationism in an American context, but it would be misleading to suggest that the debates end there.

In order to properly understand the Intelligent Design (ID) movement and why, despite its claims to the contrary, it is listed here as a supernaturalist movement, it is important to understand its history. Only by fully appreciating the political and social ramifications of ID can we hope to extricate them from the more philosophically interesting points that it raises. Although creationist doctrines can of course be traced back much earlier, we shall only need to follow the movement as far back as the early twentieth century for now in order to do this adequately. We will turn our attention to more classic discussions of theistic design in chapter six.

The Scopes trial

In 1925 the Butler Act was passed in Tennessee. This made it illegal for any school funded by the state "to teach any theory that denies the story of the Divine Creation of man as taught in the Bible, and to teach instead that man has descended from a lower order of animals" (House Bill No. 185: 1925). The act stated that any teacher found to have violated this act would be found guilty of misdemeanour and fined between one hundred and five hundred dollars. Although the act was never intended to be enforced, when the American Civil Liberties Union decided to organise a test case with substitute teacher John Scopes as the defendant, the resulting trial became "the standard to which all subsequent 'evolution trials' have been compared" (Moore, 1998a: 488-489).

Lasting only eight days, and described by *Time* magazine as "the fantastic cross between a circus and a holy war" (1925), the *Scopes* trial was a media frenzy, with the attending crowds eventually forcing the proceedings to move outside due to concerns about the strength of the courtroom floor (Moore, 1998a: 504). Scopes was found guilty, and made to pay the minimum fine of \$100, though this result was not surprising as much of the evidence presented for the defence was deemed inadmissible, and it was not disputed that Scopes had taught evolution. As Scopes' defence attorney Clarence Darrow summarised for the jury: "We cannot even explain to you that we think you should return a verdict of not guilty. We do not see how you could. We do not ask it." (Scopes, [1925] 2008: 311).

The verdict and Scopes' involvement in the trial are, and were at the time, largely irrelevant to the importance of the case. As historian Edward Larson describes an incident on the fourth day of the case, when Scopes was late to proceedings having been swimming: "When they finally showed up, Scopes could barely squeeze through the packed aisles to the defense table. 'Where the hell have you been?'

thundered Hays², but no one else appeared to notice the defendant's absence." (Larson, 1997: 170).

What made the case important was that the defence decided to use it as an opportunity to "pit science against Fundamentalism" (Moore, 1998a: 497), much of the inadmissible evidence being, to some extent, in support of this cause. This was not to say that the defence wanted to use science to prove religion wrong, but rather to keep theological doctrine out of the scientific forum. As Dudley Malone, a key member of the defence team told the court: "science and religion embrace two separate and distinct fields of thought and learning [...]. [T]here is no conflict between evolution and Christianity." (Moore, 1998a: 500). Here we see our first example of an anti-supernaturalist (insofar as he was an opponent of creationism) presenting an explicitly pro-separationist claim.

Unlike the defence, it is a little difficult to categorise the prosecution team at the trial when it comes to the separation debate. William Jennings Bryan, in a response to Clarence Darrow, another member of the defence team, argued that: "Darrow is an atheist, I'm an upholder of Christianity. That's the difference between us... If evolution wins, Christianity loses." (Moore, 1998a: 497). Whilst this clearly places Bryan in the supernaturalist camp, it is not so obvious where he stood on separation. By arguing that evolution stands in opposition to Christianity he implicitly denies Malone's claim that science and religion occupy "distinct fields". However, this is not to say that Bryan believed that Christianity could be scientifically verified, or that any amount of scientific support for evolution might falsify it. Whilst the notion of evolution standing in opposition to Christianity is key to understanding the Intelligent Design movement, in order to see creationism begin to take an explicitly anti-separationist stance we need to move our story forward by more than thirty years.

² Arthur Garfield Hays was a member of the defence team in the Scopes trial.

Scopes' legacy

In the decades following the *Scopes* trial, the teaching of evolution in American schools, as well as its inclusion in textbooks, was dramatically reduced. "The best-selling textbooks downplayed or ignored evolution. Pro-evolution books did not sell well, and the best-selling biology textbook did not include the word *evolution*." (Moore, 1998b: 576, emphasis as original). This trend continued all the way up until 1958 when, inspired by fears that the Soviet Union had overtaken the United States, particularly following the launch of Sputnik I, President Eisenhower requested that the National Science Foundation "develop state-of-the-art science textbooks" (Moore, 2002: 33). The resulting overhaul put evolution squarely back in the biology classroom and, as a result, put the debate back into the courtroom.

Following the anti-evolution success in Tennessee, an Act had been passed in Arkansas in 1928 prohibiting the teaching of evolution in any state-funded institution (Moore, 1998c: 651-657). Although there had been attempts to repeal the law, it was not until 1965 when biology teacher Susan Epperson, backed by the Arkansas Education Association, filed the first lawsuit to challenge an anti-evolution law since *Scopes*. Although Epperson won her case, the decision was reversed by Arkansas Supreme court in 1967. Epperson appealed, and eventually the evolution debate reached the United States Supreme Court. The court deemed that the anti-evolution law was unconstitutional both on the grounds of being too vague, and because it attempted to establish a religious position in a public school:

The overriding fact is that Arkansas' law selects from the body of knowledge a particular segment which it proscribes for the sole reason that it is deemed to conflict with a particular religious doctrine; that is, with a particular interpretation of the Book of Genesis by a particular religious group. (*Epperson v. Arkansas* (1968) 393 U.S. 97)

The most significant outcome of the Epperson case to our discussion is that it deemed the creationist account to be in violation of the First Amendment to the Constitution, which states that: "Congress shall make no law respecting an establishment of religion" (US Embassy, 2016). Publicly funded institutions were

thus thought to be unable to teach anything that favoured one particular religion over another. This forced creationists to rethink their strategy if they wanted to introduce anything opposing evolutionary theory into a science classroom. The 1970s thus saw creationism rebranded as 'creation science', an attempt to get around the unconstitutionality of presenting religion in a classroom by arguing that there were scientific reasons for opposing the evolutionary account (Moore, 1999: 14). This eventually led to our next case, with a court in Arkansas making a decision on the very topic of this thesis: 'can a supernatural account of reality be considered scientific?'

McLean v. Arkansas

McLean v. Arkansas board of education is perhaps the most important case in the history surrounding our topic. As Randy Moore argues, the trial is "unique and remarkably instructive, not just for understanding the evolution/creationism debate, but also because it provides legal analysis of what science is and what science isn't" (1999b: 92). As well as including arguments from creationists, now under the banner of creation science, the trial also introduced Michael Ruse as an expert witness against creationism. Many of the arguments that will be discussed over the course of our discussion have some basis in the testimonies and conclusions of this particular trial.

In 1981, the state of Arkansas passed *Act 590* into law. In light of the *Epperson* case, the act prohibited "religious instruction or references to religious writings". In addition to demanding that "public schools within this State shall give balanced treatment to creation-science and to evolution-science", the Act also included the statement that:

Creation-science is an alternative scientific model of origins and can be presented from a strictly scientific standpoint without any religious doctrine just as evolution-science can, because there are scientists who conclude that scientific data best support creation-science and because scientific evidences and inferences have been presented for creation-science. (*Arkansas Act 590*, 1981)

When the Act was opposed in court by the American Civil Liberties Union, Robert Cearley's opening statement argued that "creation science, far from being science, is actually religious apologetic" and that it "could not exist in the world of science, and does not use the scientific method" (Moore, 1999b: 93).

We see here two important and distinct objections to treating creation science as science. Firstly, that it is religious doctrine and thus teaching it in a classroom would be unconstitutional. This objection requires careful analysis, as it is a very different thing to say that creation science should not be taught in schools because it violates the separation of church and state, and to say that creation science is not science because it contains religious doctrine. In this section we have seen that a large motivation for creationists to appear scientific is that it brings the political benefit of allowing their beliefs to be taught in classrooms. It is very important, in the interests of philosophical rigour, not to adopt the contrary approach of dismissing their arguments solely in order to keep such beliefs *out* of classrooms. It is also, in the interest of fairness, worth noting the plausible motivation of separationists to conclude that creationism is *not* scientific for exactly such reasons. Additionally, and as we shall address in much more detail beginning in chapter two and continuing throughout our discussion, Cearley's argument that creation science "could not exist in the world of science" raises the obvious question of what exactly the world of science is, and on what grounds we should exclude creation science from it.

The second objection presented here is the claim that creation science "does not use the scientific method". This argument raises yet another question: even if we assume that creation scientists had not up until that point been using the scientific method, is there any reason in principle to suppose that they could not ever be capable of doing so? I will discuss this kind of objection later in this chapter and throughout the thesis, but for now we shall focus on the answers given by the court.

Regarding the first objection, Judge William R. Overton began by concluding that according to the definition given in *Act 590*, creation science was religious in nature. "Both the concepts and wording [...] convey an inescapable religiosity [...]. Every

theologian who testified, including defence witnesses, expressed the opinion that the statement referred to a supernatural creation which was performed by God" (Dorman, 1996). As well as deeming that teaching creation science in public schools was thus unconstitutional, he went on to outline five criteria which a theory must satisfy in order to be scientific, and against which, he argued, creation science fails:

- (1) It is guided by natural law;
- (2) It has to be explanatory by reference to natur[al] law;
- (3) It is testable against the empirical world;
- (4) Its conclusions are tentative, i.e. are not necessarily the final word; and
- (5) It is falsifiable. (Dorman, 1996)

We can see that the criteria (1) and (2) are an extension of Cearley's first objection, and also are a concrete example of an answer to the question of this thesis. The *McLean v. Arkansas* case concluded that science was limited to an investigation of the natural world, and natural explanation. Religious and, more specifically, supernatural hypotheses were not within the domain of science. This is the second time in this chapter that we have seen a pro-separationist stance being taken in a courtroom, and questioning the validity of this claim is the primary focus of this thesis.

The final three criteria presented by Judge Overton are a more explicit wording of Cearley's second objection: that creation science fails to conform to scientific method. These criteria suggest that even if creation science could, in principle, be categorised under the domain of science, there are methodological reasons for its exclusion. This sort of objection will be given less attention than the first for most of this investigation, but will be discussed in detail in chapter five.

Both of these types of objection were raised again in the case of *Edwards v. Aguillard* in 1986 when a similar case made it to the U.S. Supreme Court. Notably, an *amicus curiae* brief was agreed upon by 72 Nobel Laureates, 17 state academies of science, and seven other scientific organisations. This brief included the statement that "Science is devoted to formulating and testing naturalistic explanations for natural phenomena [...]. Science is not equipped to evaluate supernatural explanations for

our observations; without passing judgment on the truth or falsity of supernatural explanations, science leaves their consideration to the domain of religious faith" (*Edwards v. Aguillard* , 1986). By the late 1980s, the idea of science as a naturalistic enterprise was well entrenched in U.S. law.

The rise of Intelligent Design

In light of the *Epperson*, *McLean* and *Aguillard* cases, it should be becoming apparent why so-called Intelligent Design theorists attempted to distance themselves from any religious connotations. In 1989 a biology textbook was published entitled *Of Pandas and People*, which advocated Intelligent Design. The book was arguably the first to use the phrase 'Intelligent Design' in its current form, and defined it as follows:

Intelligent Design means that various forms of life began abruptly through an intelligent agency with their distinctive features already intact – fish with fins and scales, birds with feathers, beaks and wings, etc. (Davis and Kenyon, [1983] 2004: 99-100)

A decade and a half later, in 2004, Dover Area School District issued a press release stating that teachers at Dover High School would have to read the following statement to ninth grade biology students:

The Pennsylvania Academic Standards require students to learn about Darwin's Theory of Evolution and eventually to take a standardized test of which evolution is a part.

Because Darwin's Theory is a theory, it continues to be tested as new evidence is discovered. The Theory is not a fact. Gaps in the Theory exist for which there is no evidence. A theory is defined as a well-tested explanation that unifies a broad range of observations.

Intelligent Design is an explanation of the origin of life that differs from Darwin's view. The reference book, *Of Pandas and People*, is available for students who might be interested in gaining an understanding of what Intelligent Design actually involves.

With respect to any theory, students are encouraged to keep an open mind. The school leaves the discussion of the Origins of Life to individual students and their families. As a Standards-driven district, class instruction focuses upon

preparing students to achieve proficiency on Standards-based assessments.
(*Kitzmiller v. Dover Area School District* [2005a] 04cv2688)

When the constitutionality of the press release was brought into question at the *Kitzmiller v. Dover Area School District* trial in 2004, the plaintiffs opposing the release brought early manuscripts for *Of Pandas and People* as exhibits. They showed that in between 1986 and 1987, around the time that *Edwards v. Aguillard* had deemed teaching creation science unconstitutional, the title of the manuscript had changed from *Biology and Creation* to *Of Pandas and People*. It was also found that cognates of the term 'creationism' had been replaced with the phrase 'intelligent design', including in the definition presented above (Scott and Matzke, 2007: 8674). Regardless of its proper definition, Intelligent Design is clearly historically rooted in creation science and, by extension, creationism.

The court ruled that the policy laid out by the Dover Area School District was unconstitutional because Intelligent Design forwarded a religious agenda. In addition to this, as in the *McLean v. Arkansas* case, the court also made a determination on whether Intelligent Design counted as science. Judge John E. Jones III concluded that "ID violates the centuries-old ground rules of science by invoking and permitting supernatural causation" (Wexler, 2006-2007: 94). Once again, we see that a U.S. court advocated a pro-separationist position.

Although legal decisions do not necessarily have to adhere to philosophical standards, it is worth noting that the courts have gone above and beyond the legal requirements in order to determine that Intelligent Design is not science. As Professor of Law, Jay D. Wexler argues: "The overall question posed to a court is whether teaching ID endorses *religion*, not whether ID is or is not *science*. The part of *Kitzmiller* that finds ID not to be science is unnecessary, unconvincing, not particularly suited to the judicial role, and even perhaps dangerous both to science and to freedom of religion." (2006-2007: 93).

I intend to argue throughout this thesis that the courts have, over the course of its history, been wrong to deny that Intelligent Design and its predecessors could qualify

as science *in principle*. Before moving away from Intelligent Design however, let us note two important points. Firstly that Intelligent Design, as a direct descendent of creationism, *is* a pro-supernaturalist position. This is illustrated in the legal history we have just outlined, and although one could theoretically adopt a non-supernaturalist position in defending ID, both the literature and this thesis ignore this possibility. In the case of this discussion, the possibility of non-supernaturalistic ID being scientific is of little concern to us, as I am specifically arguing for the possibility of supernaturalistic hypotheses being scientific (potentially including supernaturalistic ID), which is a more difficult position to defend. Secondly, the fact that creation science and ID are supernaturalist positions has been a key factor in the legal determinations that they are not science. In particular, this has involved the objection that supernaturalist claims violate natural laws; an objection that will be discussed much more fully in chapter four.

Other Pro-Supernaturalist, Anti-Separationist positions

Although thus far I have given much attention to the creationist movement (understood as opposing the claims of evolutionary theory), they are not alone in advocating scientific investigation of the supernatural. Christian philosopher of religion Alvin Plantinga has expressed his support for *guided* evolution and, although it is sometimes unclear whether he himself is strictly anti-separationist, he has offered some arguments in favour of such a position.

Plantinga argues that if one assumes that supernatural phenomena lie beyond the scope of scientific enquiry, then one is faced with a problem if any supernatural claim happens to be true. As he argues: "If you exclude the supernatural from science, then if the world or some phenomena within it are supernaturally caused [...] you won't be able to reach that truth scientifically" (2006). This is a reasonable objection, and it is important to stress here that the intent of this thesis is not to be critical of supernaturalistic positions. Although much attention is paid to creationism, a particularly derided form of supernaturalism, I hope to argue against separationism in a way that can be accommodated equally by the supernaturalist

and the naturalist. Abandonment of the separationist position not only allows us the opportunity to criticise supernaturalist claims scientifically, but also to defend them, provided that evidence in either direction is actually accessible.

In his 2011 book *Where the Conflict Really Lies*, Plantinga argues further that supernatural phenomena cannot constitute violations of laws of nature. He argues that scientific laws, at least when understood classically, apply only to closed systems, and that in an event such as a miracle, where God has intervened to alter some state of affairs, then the system in question is no longer causally closed. He concludes that it is therefore inaccurate to describe miracles as *violations* of laws of nature:

Miracles are often thought to be problematic, in that God, if he were to perform a miracle, would be involved in "breaking", going contrary to, abrogating, suspending, a natural law. But given this conception of natural law, if God were to perform a miracle, it wouldn't at all involve contravening a natural law. That is because, obviously, any occasion on which God performs a miracle is an occasion when the universe is not causally closed; and the law says nothing about what happens when the universe is not causally closed. (2011: 82-83)

As I have already stated, the concept of supernatural phenomena as being violations of laws of nature will be the subject of a later chapter, but we can see here one of the potential avenues that one might take in response to the conclusions of, for example, the *Arkansas* case.

Alternative, and less theistic, examples of notable pro-supernaturalist positions can be found discussed in much of the literature on 'pseudoscience', with perhaps the most common example being that of astrology. The discussion as to the exact nature of 'pseudoscience' and the accompanying 'demarcation debate' is something that we will inevitably encounter often throughout this investigation. I will not, however, be offering a great deal of explicit input on this subject until the end of our discussion. Nonetheless we will touch upon these other examples of supernatural phenomena, as well as the demarcation debate, in chapters two and three.

Finally, and perhaps controversially, I will argue that we can trace an anti-separationist position, both from pro-supernaturalists *and* anti-supernaturalists, back to the classic arguments surrounding natural theology. I will argue that while the contemporary Intelligent Design movement has clear roots in more historical design arguments, one can find similar relationships to scientific method in contemporary cosmological arguments, as well as in the modern evidential problem of evil; I shall tentatively develop this argument in chapter six.

The normative aspect of the debate

Before moving on to the three remaining positions in the debate, I wish to address one final point on the political ramifications of Intelligent Design. Even if we grant that Intelligent Design theory, or even unabridged creationism, were scientifically investigable, this does not necessarily imply that they should be taught in science classrooms. As we shall see in our discussion of the anti-supernatural, anti-separationist position, granting that supernatural phenomena might be scientifically investigated does nothing to suggest that upon such investigation they will be scientifically *supported*.

Of course, conversely, if Plantinga is correct then perhaps scientific investigation *would* lead to such support. The only reason then to exclude the supernatural from science would appear at least to be political in nature, and this is exactly the kind of motivation that this chapter aims to extract from our discussion. If we wish to treat science as in some way pursuing truth, and we show that supernatural phenomena or hypotheses *can* be scientifically investigated, then we *should* allow that such investigation can occur. This is to say nothing regarding our expected outcome of such investigation, and is I hope a normative claim that can be accepted by both proponents and opponents of supernaturalistic belief.

I would argue further that we do not need to go so far as to establish that supernatural phenomena or hypotheses can be scientifically investigated in order to reject a separationist position, but only that there is no justification for assuming

that they *cannot* be investigated. Throughout this thesis we will encounter situations in which the only way to establish whether or not certain criteria for science can be applied to scientific hypotheses will be to actually investigate the hypothesis in question first. Therefore unless we have *a priori* reasons for accepting the separationist position, which is a claim I intend to refute, then we should not adopt it. Given the legal and political ramifications associated with the exclusion of the supernatural from science, I suggest that the burden of proof lies with the separationist in establishing their view and, I will argue, it is one they have not met.

This issue is of particular import when we come to more esoteric conceptions of criteria for science. At some points in our discussion I will concede that the separationist could establish that science cannot investigate the supernatural by relying on a definition of 'science' which is highly controversial, or relatively unknown. However, while such approaches are philosophically interesting and offer potential avenues for future research, I would argue it is irresponsible to extend them beyond the sphere of philosophy and into legal and political discourse at this stage in the debate.

Intelligent Design represents but one facet of the supernaturalist, anti-separationist camp, but it serves well to illustrate the motivations that might bias such a position, as well as hint at those of its detractors. This has particularly been the case in the United States, where one of the most religious cultures in the developed world (Gao, 2015) arguably finds itself at odds with its own constitution. It would be easy to assume that the Machiavellian approach taken by some leading proponents of Intelligent Design represents the only strong bias in this debate, but this would be unfair. Let us now turn our attention then to the completely opposite camp, where anti-supernaturalist, pro-separationists defend their position equally fiercely.

Anti-supernaturalist, Pro-separationists

Ruse and nonoverlapping magisteria

I mentioned in the previous section that one of the key witnesses in the *McLean v. Arkansas* case was philosopher of science, Michael Ruse. As well as being an atheist and a proponent of separation between science and religion, Ruse is also a vehement opponent of the Intelligent Design movement. Although as noted at the beginning of this chapter, he has attempted to adopt a 'middle ground' position more recently, during the trial his arguments came from a far less balanced perspective. As Ruse himself acknowledges when discussing the 1981 case: "I cannot pretend that I thought all that deeply about the issues, at least not at a philosophical level. For me, it was less an intellectual experience and more a crusade against something I regarded (and still so regard) as an insult to all of the learning I hold dear – an insult to nonbeliever and believer alike." (2011: 656). Bearing this in mind, let us consider some of Ruse's arguments in favour of excluding Intelligent Design from the domain of science.

Unsurprisingly given his involvement in the Arkansas case, Ruse's arguments have mirrored to a large extent the conclusions of Judge Overton. In a 1982 article in which he discussed some of his reasoning during the case, Ruse echoed Overton's conclusion: "Religious beliefs frequently allow or suppose events outside law or else events that violate law (miracles) [...]. This is not to say that religion is false, but it does say that religion is not science." (1982a: 73). This is yet another example of Cearley's first objection being made, this time in an explicitly philosophical context.

This kind of objection can be summarised by the claim that, as philosopher Robert T. Pennock argued at the *Kitzmiller v. Dover Area School District* trial: "a characteristic of modern science is a commitment to what's called methodological naturalism" (*Kitzmiller v. Dover*, 2005b). That is to say that science operates under the *methodological* assumption that naturalism is true, and must refer only to natural causes and explanations. As Plantinga describes it:

The philosophical doctrine of methodological naturalism holds that, for any study of the world to qualify as "scientific," it cannot refer to God's creative activity (or any sort of divine activity). The methods of science, it is claimed, "give us no purchase" on theological propositions--even if the latter are true--and theology therefore cannot influence scientific explanation or theory justification. Thus, science is said to be religiously neutral, if only because science and religion are, by their very natures, epistemically distinct. (1997: 143)

In addition to conformity to natural law, Ruse lays out a series of other criteria for science, which he feels are lacking in the case of Intelligent Design. These go beyond Judge Overton's five criteria and are, in the order presented by Ruse: "explanation and prediction", "testability, confirmation and falsifiability", "tentativeness", and "integrity" (1982a: 75-76). Each of these criteria shall be discussed individually in chapter two, and then the more complex issues arising from them given further attention in chapters four and five.

Nonoverlapping magisteria

Since the 1981 trial, Ruse's views have softened significantly. In a very similar manner to the intentions of this chapter, he has tried to pull apart the biases and confusions surrounding the debate. Describing the period when Intelligent Design was beginning to emerge, Ruse writes:

Many of us in the business were still accepting some version of the independence theory, but uncritically. This was shown dramatically by Stephen Jay Gould's *Rocks of Ages* (1999), which argued that science and religion are nonoverlapping "Magisteria", but which then took away from religion the right to make any ontological claims about the existence of God and His creative power and so forth. Part of the problem here was that many if not most people writing on science and religion — I exclude the full-time historians who were a different (and much better) matter — simply did not have the needed training in philosophy and theology. (2011: 658)

Gould's concept of nonoverlapping magisteria (NOMA) is frequently cited in discussions of science and religion, and it neatly summarises the separationist position. He argues that science and religion, whilst both valid pursuits, ask different questions and occupy different intellectual spaces:

The net of science covers the empirical universe: what is it made of (fact) and why does it work this way (theory). The net of religion extends over questions of moral meaning and value. These two magisteria do not overlap, nor do they encompass all inquiry (consider, for starters, the magisterium of art and the meaning of beauty). To cite the arch clichés, we get the age of rocks, and religion retains the rock of ages; we study how the heavens go, and they determine how to go to heaven. (1997: 17-18)

This NOMA principle, as expounded by Gould, is often forwarded as a way for science and religion to live harmoniously with one another, and as a way to encourage amicable dialogue between the two domains. This is in sharp contrast to the situation we saw in the debate between evolution and Intelligent Design. As Gould describes it: "Here, I believe, lies the greatest strength and necessity of NOMA, the nonoverlapping magisteria of science and religion. NOMA permits — indeed enjoins — the prospect of respectful discourse, of constant input from both magisteria toward the common goal of wisdom" (1997: 62). It is rejection of the NOMA principle that pits creationism against evolution.

We have seen that Ruse now feels that NOMA strips religion of its ontological force. Moreover, if we remember Plantinga's concerns regarding the imposition of limitations on science in a situation where a particular supernatural proposition happens to be true, then we see that from a religious perspective, NOMA could be an incredibly damaging proposition. The creationist is thus not entirely unjustified in rejecting it. We shall see towards the end of this chapter that the principle has also received harsh criticism from the extremely anti-religious as well. However, as illustrated by the legal history of the discussion, as well as numerous statements from organisations such as the American Association for the Advancement of Science, and the National Academy of Science to the same effect (Fishman, 2009: 814-815), the position has found heavy favour in prominent non-philosophical circles, as well as still receiving support (to be discussed) from various representatives of the philosophical community. Before getting to those objections and their accompanying supporting arguments however, let us now turn to the third camp on our list.

Pro-supernaturalist, Pro-separationists

Don't poke the bear

Supernaturalist supporters of separation are, arguably, the least proactive participants in this debate. Unlike the Intelligent Design theorists, they see no conflict between science and religion, and thus are unthreatened by the propagation of evolutionary theory. Religious views presented in a church face none of the opposition they would in a science classroom, nor in a courtroom. Equally, unlike non-supernaturalistic advocates of separation, they have no need to keep anyone out. There is no equivalent to the Intelligent Design movement attempting to force evolutionary theory into weekly mass.

Where supernaturalist supporters of separation *do* become vocal however is when they feel that science is stepping on religion's toes. Though there is no counterpart to the ID attempts to insert themselves into the science-occupied domain of a science classroom, such potential impositions *can* be seen to occur in the public domain. A notable recent example of this occurred in 2010 when physicists Stephen Hawking and Leonard Mlodinow published *The Grand Design*, in which they made the claim that scientific progress had eliminated the need to appeal to a divine creator of the universe:

Because there is a law like gravity, the universe can and will create itself from nothing [...]. Spontaneous creation is the reason there is something rather than nothing, why the universe exists, why we exist. It is not necessary to invoke God to light the blue touch paper and set the universe going. (2010: 227)

News of the book's contents preceded its release, and it led to an outcry from numerous religious leaders. On the 3rd of September 2010, six days before the book was released, *The Times* ran a front page story entitled: 'Hawking: Archbishop leads religious response'. The article included quotes from various sources including Dr. Rowan Williams, the then Archbishop of Canterbury:

Belief in God is not about plugging a gap in explaining how one thing relates to another within the Universe. It is the belief that there is an intelligent, living agent on whose activity everything ultimately depends for its existence. Physics

on its own will not settle the question of why there is something rather than nothing. (Devlin and Gledhill, 2010)

The article also contained a quote from Chief Rabbi Lord Jonathan Sacks, who took a more explicitly separationist view:

Science is about explanation. Religion is about interpretation [...]. The Bible simply isn't interested in how the Universe came into being. (2010)

Hawking and Mlodinov's scientific rejection of God echoes another oft cited story of a scientist 'eliminating' the need for divine providence. So the story is told, Emperor Napoleon I asked Pierre Simon LaPlace why there was no mention of a creator in his account of the workings of the solar system, *Exposition du système du monde* (1796). LaPlace simply responded: "Je n'avais pas besoin de cette hypothèse-là" [I had no need of that hypothesis] (Wagner and Briggs, 2016: 261).

In *God's Undertaker: Has Science Buried God?*, Lennox argues that approaches such as those of Hawking, Mlodinow and LaPlace are misguided. He gives the example of a woman, Aunt Matilda, who has baked a cake. According to Lennox, scientists could break down the cake via the methods of physics or chemistry, and give a very detailed description of the cake. They would not, however, be able to tell us *why* she baked the cake. "In fact, the only way we shall ever get an answer is if Aunt Matilda reveals it to us. But if she does not disclose the answer to us, the plain fact is that no amount of scientific analysis will enlighten us." (2007: 40).

Lennox offers a second example, involving the analysis of a Ford motor car: a person who has never seen such a machine takes it apart in order to see how it works. First suspecting that there might be a god inside the engine, making it work. On investigation, he finds no such being, and furthermore:

His grasp of the impersonal principles of internal combustion would be altogether enough to explain how the engine works. So far, so good. But if he then decided that his understanding of the principles of how the engine works made it impossible to believe in the existence of a Mr Ford who designed the engine in the first place, this would be patently false – in philosophical terminology he would be committing a category mistake. (2007: 44)

Turning his attention explicitly to LaPlace, Lennox argues that there is no more reason for God to appear in a mathematical description of the workings of the solar system, than there would be reason for Henry Ford to appear in a scientific analysis of internal combustion (45). He then quotes Austin Ferrar in *A Science of God?*:

Since God is not a rule built into the action of forces, nor is he a block of force, no sentence about God can play a part in physics or astronomy... LaPlace and his colleagues had not learned to do without theology; they had merely learned to mind their own business. (1966: 29-30)

I will not attempt to refute the claim that some supernatural phenomena lie outside of the reach of science. There is plausibly little reason to suppose that a scientist should be able, as in the example put forward by Lennox, to discover anything about Henry Ford from the workings of internal combustion, beyond perhaps his proficiency at engineering. Though it should be noted that such reasoning lies in direct opposition to the design inferences forwarded by some in the pro-supernaturalist, anti-separationist camp, and attempts at inferences of this sort will be discussed in chapter six. What I hope to argue instead, over the course of this work, is that this limitation is not the result of a phenomenon being supernatural. Indeed, this becomes especially apparent with the Ford example in mind, as the difficulty for science there has nothing to do with supernaturalism. Conversely, I will argue, there are some phenomena which may defensibly be thought of as 'supernatural' which *could* fall into the scientific domain. Thus the property of being supernatural is neither a necessary, nor sufficient criterion for exclusion from scientific investigation.

By believing that science could eliminate the need for God in understanding the universe, Hawking, Mlodinow and LaPlace have all implicitly placed themselves into our final category of thinker. A better understanding of their views will help elucidate some of the limitations of Lennox's argument. Let us therefore now lastly turn our attention to anti-supernaturalist opponents of the separation of science and the supernatural.

Anti-supernaturalist, Anti-separationists

Where Dawkins and Intelligent Design agree

As I said in the introduction to this chapter, by 'anti-supernaturalist' I only mean to imply opposition to any particular supernatural phenomena being discussed. It is partly for this reason that I employ the term 'anti-supernaturalist', rather than simply 'naturalist'. There is however a group of thinkers, most vocally represented by the so-called 'New Atheists', who feel that scientific investigation has actively *disproved* the existence of supernatural phenomena. For them, putatively supernatural claims, such as the existence and action of a divine creator, are not things on which science has nothing to say. Rather, like the existence of phlogiston and the ether, they fall within the domain of scientific investigation, but the evidence has weighed against them.

We have seen that Hawking and Mlodinow implicitly adopted this approach in *The Grand Design*, and there is some weight to the idea. If scientific investigation can fully explain the universe in natural terms, then this would suggest that invoking supernatural causation would seem to *overdetermine* the universe. At the very least, it would render inferences to a theistic creator – a topic we will discuss in chapter six – harder to justify.

The indirect form of investigation demonstrated by both LaPlace's comments and those articulated in *The Grand Design* does not explicitly suggest that science can investigate the supernatural, but rather that science is not mute on the subject of supernatural phenomena when their existence would contradict established scientific theory³. If, for example, we reject the possibility that an event can have two independently sufficient causes, or at least consider this to be highly unparsimonious, then evidence in favour of one particular cause will necessarily be evidence against another. This is a similar conclusion to that drawn by creationists when they felt that evolutionary theory was incompatible with, and thus threatening

³ Note that this is not unique to the investigation of supernatural phenomena. Consider for example the competitive relationship between phlogiston theory and Lavoisier's theory of combustion.

to, the Biblical account of creation told in Genesis. Though in many such cases the conflicts are somewhat deeper, particularly in the sub-category of creationists who believe in a young Earth. The universe cannot be both six thousand and fourteen billion years old.

It is worth noting that this kind of analysis is one-directional. Evidence in favour of a theory is weighed against other theories to the extent that if, say, it were confirmed with absolute certainty that evolution were true, we could be equally certain that creationism was false. This does not apply in the case where evidence counts *against* a particular theory. Disproving evolutionary theory could only confirm the truth of creationism if there were only two possible options available. It is not sufficient to show that one of two *suggested* options is false. It is a frequent, and misguided, approach of creationists to attempt to defend their theories by exactly this method (Pennock, 2006: 468-471).

The indirect rejection of supernatural explanations by confirming natural ones is a fairly cumbersome and inefficient method of investigation. If one is tasked with discrediting some supernatural explanation (such as divine creation of the universe), then one must come up with a full, well-supported model of how such an event happened naturally. Moreover, once again remembering Plantinga's objection, it offers no recourse for science if any supernaturalist claim happens to be true. One would have to eliminate all naturally possible models before arriving at the conclusion that a nonnatural model *must* be correct, and then still have no obvious method for establishing *which* nonnatural model is indeed correct⁴.

If this analysis holds true, then it seems that it would be of benefit both to supernaturalists and anti-supernaturalists if science were able to investigate supernatural phenomena. As stated in the previous section, I will not attempt to argue that *all* supernatural phenomena might be investigable by scientific means.

⁴ The Roman Catholic Church does adopt a method similar to this in establishing the occurrence of a miracle for the purposes of beatification and canonisation. We shall touch upon this issue again in chapter four.

Lennox's Henry Ford problem is not one that I wish to refute in its entirety. However, it can be argued that *some* supernaturalist claims could, in principle, be scientifically tested. This is a claim that has been very popular amongst the 'New Atheist' movement.

Richard Dawkins' philosophical credentials have received frequent criticism, even from fellow atheists. As Michael Ruse (2009) expresses his opinion on the matter: "Richard Dawkins in *The God Delusion* would fail any introductory philosophy or religion course. Proudly he criticizes whereof he knows nothing". However, he is unquestionably one of the key current figures in the debate, and it would be remiss of me not to mention him here. In addition, Dawkins occupies the opposite extreme to creationists on the spectrum in which Ruse wishes to find himself a 'middle ground', despite apparently agreeing with them on the subject of separationism, so it is useful that we understand exactly what such a view actually entails.

Dawkins is strongly opposed to Gould's NOMA principle, and he argues against it in two distinct ways. The first, while not important to our core question, is relevant to the issue of bias in the debate and thus does warrant brief mention here. Dawkins argues that the only reason that those in the pro-supernaturalist, pro-separationist camp endorse NOMA is because there is no evidence in favour of what he calls 'the God hypothesis':

Did Jesus have a human father, or was his mother a virgin at the time of his birth? Whether or not there is enough surviving evidence to decide it, this is still a strictly scientific question with a definite answer in principle... To dramatize the point, imagine, by some remarkable set of circumstances, that forensic archaeologists unearthed DNA evidence to show that Jesus really did lack a biological father. Can you imagine the religious apologists shrugging their shoulders and saying anything remotely like the following? 'Who cares? Scientific evidence is completely irrelevant to theological questions.' (Dawkins, 2006: 59)

Dawkins is of course engaging in sheer speculation here, but the point he raises is compelling. We have seen throughout the course of this chapter that it is natural for a person to rush to defend their position with whatever evidence is available to

them. We have already seen that Ruse was willing to employ Popperian falsifiability against creation science despite it being, in his words, a "rough and ready" approach. It is thus certainly worth being aware that pro-supernaturalist supporters of separation may be being swayed in exactly the way that Dawkins suggests.

Dawkins' second objection to NOMA is more philosophical, and is more akin to a form of argument that I will defend throughout this thesis. He argues that the NOMA principle only applies to a weak kind of theism, one that eliminates miracles, and that this is not the kind of theism we see in practice:

The moment religion steps on science's turf and starts to meddle in the real world with miracles, it ceases to be religion in the sense Gould is defending and his *amicabilis concordia* is broken. Note, however that the miracle-free religion defended by Gould would not be recognized by most practising theists in the pew or on the prayer mat. (2006: 60)

Dawkins' point can, I will argue, be extended to any supernatural phenomenon that has an empirically testable effect on the universe. This is a claim that is advantageous to both supernaturalists, under Plantinga's argument, and anti-supernaturalists who wish to refute such phenomena. As Larry Laudan, who was highly critical of Ruse's arguments in the *Arkansas* trial, notes: "By arguing that the tenets of Creationism are neither testable nor falsifiable, Judge Overton [...] deprives science of its strongest argument against Creationism" (1982: 17). If we do not allow science to directly examine the evidence for and against supernatural phenomena and hypotheses, then we lose any ability to address claims such as the truth of creationism using scientific evidence. From a normative perspective, again, science *should* be allowed to investigate supernatural claims. Moreover, if this analysis is correct, then it applies even to weak forms of separationism. The critique is not simply that scientists could investigate empirical claims, but that this investigation would allow us at least some degree of insight into the supernatural hypotheses and explanations they relate to.

I will spend much of the following discussion defending this particular argument, so I will not delve into it more deeply here. Let us for now note that we find here an

agreement between Richard Dawkins, one of the most vitriolic opponents of both creationism and religion of modern times, and the very Intelligent Design theorists he most strongly opposes. It is thus absurd to suggest that the NOMA principle represents in any way an amicable middle ground between the two positions. Rather than divided by questions over what science can investigate they are, as is perfectly scientifically valid, in opposition over who has the better evidence.

Conclusion

Over the course of this chapter we have seen that the debate over separationism can be more clearly understood if we divide the participants in the discussion along two orthogonal axes: firstly according to their position regarding whether or not science can investigate the supernatural, and secondly according to their position regarding the existence of any particular supernatural phenomenon. This approach allows us not only to analyse the discussion with greater clarity, but also helps us to highlight the difficulty in defending the separationist position as an amicable compromise between competing positions.

From a normative perspective we can observe that the separationist position, rather than acting as a middle ground encouraging the kind of "respectful discourse" proposed by Gould (1997: 62), actually does nothing of the sort. By viewing the discussion as divided into the four camps I have outlined, we can see that the separationists actually occupy one side of a two dimensional grid of beliefs. Moreover, both proponents and opponents of separationism are divided in their religious commitments. Rather than eliminating an area of potential conflict between the religious and the scientific, the separationist actually adds an extra layer of division to the discussion. By insisting that science and religion occupy distinct spheres they erect an artificial barrier to discussion between those who might otherwise engage in it.

We have seen that, historically, United States courtrooms have tended to favour a pro-separationist position when analysing the debate. However, this is to some extent going beyond the jurisdiction of a courtroom, as the only legal matter in question during these cases is whether or not a certain theory has endorsed a *religion*, and not whether or not it constitutes *science*. These responses have developed and progressed alongside the evolution of creationism from an explicitly religious position to the more purportedly scientific and religiously neutral Intelligent Design movement, though its status on both of these points has been highly (and rightly) criticised to the extent that I include it with other examples of the pro-supernaturalist, anti-separationist position.

Support for an anti-separationist position has, interestingly, been most vocally expressed by those furthest apart on the supernaturalism spectrum. Creationists, insistent in their modern form that there is scientific justification for belief in a designer, are met with agreement on the scientific investigability of God by those who, like Dawkins, believe that science has shown that belief in Him is unjustified. Though these camps perhaps shout loudest, they should not be considered alone, with similar arguments being forwarded by people such as Plantinga, Laudan and (implicitly) Hawking and Mlodinow.

Although much of our initial discussion has served to outline the status of the debate from a primarily cultural perspective, as well as to lay the groundwork for philosophical analysis in later chapters, there are some preliminary conclusions that can be drawn. Most importantly, that the separationist principle does not serve as a middle ground between competing positions, but rather indicates a position on one extreme of a continuum of views. Additionally, and in a way that somewhat informs this point, we must approach arguments regarding this debate with caution. The subject of our discussion is the debate over separationism which, despite being orthogonal to the debate over the existence of the supernatural, is deeply connected to it from a historical, cultural, and political perspective, and as such is one where people on all sides bring non-philosophical baggage to the discussion.

Chapter 2

Defining science

In the previous chapter we frequently employed the terms 'science' and 'supernatural'. In the following two chapters, we shall attempt to address the question of what exactly is meant by these terms. I intentionally here use the passive voice, as I will not be forwarding any arguments regarding what it is that these terms mean in the sense of adopting a position on the demarcation debate. Rather, I will be outlining a variety of understandings as to what might be thought to be captured, or intended to be captured, by these terms when discussed in the context of the separationism debate. It is not my aim here to solve the problem of demarcation, nor even to affirm that such a problem exists. Rather I hope to show that, if such a problem does exist, then the concept of supernaturalism does not play a useful role in resolving it.

Before discussing putative definitions for science, we will first briefly explore the context of the discussion in terms of demarcation and pseudoscience. As we have seen, the cultural and normative factors influencing discussions of these topics play a significant role in its history, and it is important to understand the rough context of these issues before progressing. The demarcation debate, along with the particularly negative connotations associated with the term 'pseudoscience', offers a good deal of insight on this subject. We will return to this issue towards the end of our analysis in chapter seven.

In order to make the incredibly wide-ranging nature of the discussion manageable, this chapter will be divided into several sub-sections. Most broadly, we shall discuss potential understandings of science in terms of three categories: content, methodology, and social structure. The first of these categories will be further subdivided into reference to natural law, reference to the natural world, and appeal to mathematics. Each shall be discussed in some detail, though the topics of both

natural law and the natural world will also receive a more detailed analysis in chapters four and six respectively.

The second broad category for science, that of methodology, will also be subdivided. We shall first address the notion of 'testability', though this will be one of many discussions on this concept throughout our investigation. Following on from testability we will consider the idea that explanation and prediction are integral to the scientific method, though again these are notions which will be appealed to throughout our discussion. Next we will briefly look at methodological naturalism as a principle in itself, followed by a short discussion of metaphysical assumptions in general, with specific reference to anti-realist approaches to science. Finally, we will discuss tentativeness and integrity as key elements in the practice of science.

The final broad category for science, that of social structure, shall be discussed in less detail than the other two. Even though it is arguably no less significant an element in discussing the nature of science, either historically or in terms of abstracted philosophy, it is somewhat tangential to our discussion. As with tentativeness and integrity, I will argue that the social structure of science does not *in principle* necessitate the exclusion of the supernatural from science, even if there are *de facto* sociological reasons that it does not currently inhabit the scientific sphere. This represents an area of significant divergence between our discussion and the demarcation debate, where such criteria are often appealed to in differentiating science from other activities.

What is science?

Intuition and pseudoscience

In spite of the ease with which we use the term 'science' it is extremely difficult to pin down a widely agreed upon definition of the word. We do, for the most part, have a clear idea of examples of things which *are* science, and things which *are not*

science. As Peter Godfrey-Smith outlines his intuitions: "The work done by physicists and molecular biologists when they test hypotheses is science. And playing a game of basketball, no matter how well one plays, is not doing science. But in the area in between these clear cases, disagreement reigns." (2003: 3). John Dupré, drawing a comparison to American Supreme Court Justice Potter Stewart's comments⁵ on obscenity ("I know it when I see it"), outlines a similar schema:

As with obscenity, there are some hardly disputable examples (sexualized violence against children; molecular genetics), some questionable cases (Anaïs Nin's erotica; evolutionary psychology), and some cases clearly outside the domain (*Sesame Street*; Tarot reading). (2001: 114)

Similarly, William Newton-Smith writes:

The dominant tendency at the moment is to reject the question... Science has no essence. We have constituted our idea of science around a list of paradigm exemplars (including biology, chemistry, geology, medicine, physics, zoology) of particular disciplines. (2001: 2)

Although I do not share Dupré's intuitions that Tarot reading is quite so clear a case of non-science (as will be discussed throughout this thesis), the overall principle outlined here at least grants us the ability to utilise the word 'science' in an effective, albeit loose, communicative capacity. We will however require a much more specific definition if we are to offer substantive commentary on the proper inclusion, or exclusion, of the supernatural from this domain.

There are, as we shall see over the course of this chapter, a variety of methods by which one might try to distinguish science from non-science while using a system that is less reliant on personal intuitions. These attempts are complicated however by the sheer breadth of activities that we would hope to include under such a definition. Although Godfrey-Smith's examples draw to mind laboratory workers studying entities and processes at the microscopic scale, we would certainly not wish to limit science to such activity, as this would exclude field work, psychology, cosmology and a whole range of other activities commonly held to be 'scientific'.

⁵ *Jacobellis v. Ohio* 378 U.S. 184, 173 Ohio St. 22, 179 N.E.2d 777 (1964).

Compounding this issue is the fact that science is not limited to any obviously specific field of enquiry, with investigations ranging from the furthest stars to the smallest microorganism and perhaps even into the human psyche. Approaches to the definition of science have thus been extremely varied, ranging from matters of the content of scientific theories, through methodology, to social aspects of the scientific process.

Due to the complexity of the issue, it may well be impossible to arrive at any set definition of what science *is*, and this issue is compounded by the fact that much philosophical discussion has instead centred on what science *is not*. The demarcation debate between science and non-science has received much attention in recent decades, and is largely focused on differentiating science from so-called 'pseudosciences'. As we saw in the last chapter, much of this discussion has involved cultural and legal issues. This is not limited strictly to discussion of the supernatural, but is deeply entrenched in discussion of science and pseudoscience generally. The term 'science' is a loaded one, with an air of grandeur about it, and it is highly tempting to think that if an approach is 'scientific' then this in some way validates it as a way to establish truth. In one of the most influential and controversial discourses on the topic, Laudan summarised this attitude towards science thusly:

We live in a society which sets great store by science. Scientific 'experts' play a privileged role in many of our institutions, ranging from the courts of law to the corridors of power. At a more fundamental level, most of us strive to shape our beliefs about the natural world in the 'scientific' image. If scientists say that continents move or that the universe is billions of years old, we generally believe them, however counter-intuitive and implausible their claims might appear to be. Equally, we tend to acquiesce in what scientists tell us not to believe. If, for instance, scientists say that Velikovsky was a crank, that the biblical creation story is hokum, that UFOs do not exist, or that acupuncture is ineffective, then we generally make the scientist's contempt for these things our own, reserving for them those social sanctions and disapprobations which are the just desserts of quacks, charlatans and con-men. (1983: 111)

Compounding the positive connotations of the word 'science', the term 'pseudoscience' is itself notably derogatory; pseudoscience is not merely non-scientific, but negatively so. A pseudoscience is not just an activity which approaches questions with a different methodology to science, as do (arguably)

religion or metaphysics for example, but it approaches these questions in a way which is quantifiably *inferior* to science. As Sven Ove Hansson (2008) notes: "It would be as strange for someone to proudly describe her own activities as pseudoscience as to boast that they are bad science."

Conversely, and to add complication to the issue, there are negative connotations to the word 'science' as well. As Godfrey-Smith notes: "[O]ccasionally, a person might call an investigation scientific in order to say something negative about it — to suggest that it is dehumanizing, perhaps. (The term 'scientistic' is more often used when a negative impression is to be conveyed.)" (2003: 3). Moreover, an overconfidence in science, or excessive attachment to it, draws similar ire, with Dupré offering a particularly scathing appraisal:

[W]hat I call scientism, an exaggerated and often distorted conception of what science can be expected to do or explain for us. One aspect of scientism is the idea that any question that can be answered at all can best be answered by science. This, in turn, is very often combined with a quite narrow conception of what it is for an answer, or a method of investigation, to be scientific [...]. Together these ideas imply a narrow and homogeneous set of answers to the most diverse imaginable set of questions. (2001: 1-2)

Whilst I sympathise with perspectives on both sides of the debate over the status of science, it is important to note that our present discussion is intentionally trying to *remove* such opinion from the issue. I make no claims as to whether or not science can be successful in the goals it pursues, nor do I wish to propound or dispute any supposed benefits of the scientific method, if such a beast exists at all. The focus of this discussion is specifically directed at the implications of 'supernaturality' (for want of a better term) for a particular hypothesis or phenomenon's viability as a subject for scientific analysis. If a scientific method is (un)successful or (un)desirable in a naturalistic context then it will, in general, be similarly (un)successful or (un)desirable in a supernaturalistic context.

Although 'pseudoscience' is by no means synonymous with 'investigation of the supernatural', there is a clear overlap between the extensions of the two terms. Whilst there are many putative examples of non-supernatural 'pseudosciences', such

as ufology or holocaust denialism, a large proportion of those pursuits regarded as pseudoscientific contain at least some supernatural elements. Hansson (2008) identifies astrology, dowsing and, as we have seen, creationism as examples, but as we saw earlier even Dupré, who is strongly opposed to scientism, considers Tarot reading to be clearly unscientific (though perhaps not 'pseudoscientific').

These examples reflect a common consensus, rather than a reasoned taxonomy. Hansson loosely defines a pseudoscience as an activity which is not scientific but whose "major proponents try to create the impression that it is scientific" (2008). Though he continues on to observe that such a definition neither seems necessary nor sufficient in identifying those practices which we wish to call pseudoscientific. On the one hand, astrologists are not known for claiming themselves to be scientists. On the other, accepting this definition would compel us to refer to those committing scientific fraud as practicing pseudoscience. Hansson is however just one of a great number of people who have attempted to properly define the term, and we will encounter several potential approaches throughout the discussion.

Given the above considerations it is likely both imprudent and unnecessary for me to embroil myself in a debate which, as Laudan famously argued, may ultimately prove unresolvable: "The evident epistemic heterogeneity of the activities and beliefs customarily regarded as scientific should alert us to the probable futility of seeking an epistemic version of a demarcation criterion" (1983: 124). Rather than attempt to provide any set definition of what science is, or what it is not, I will instead collate a 'shopping list' of qualities which science has been thought to possess over the course of the debate, in order to determine whether or not any of them prove incompatible with supernatural investigation. In addition to this, due to the great disparity in phenomena considered to be supernatural, a similar list of qualities will be required in that regard in chapter three.

In order to be as comprehensive as possible in appraising the compatibility of science and the supernatural, I shall not overtly challenge any particular definition. For example, whilst there have been numerous criticisms laid against Popperian

falsifiability, I shall grant it the maximum benefit of the doubt. The question is not whether or not falsifiability *is* an attribute of science but rather, *if it were* an attribute of science, would this preclude supernatural investigation? I will however occasionally identify where a criterion would preclude a particularly obvious example of a scientific endeavour, in order to show that it is inconsistent, or at least contentious, to reject the supernatural on the basis of this criterion alone.

It is worth noting here that this approach is not intended as an endorsement of the possibility of necessary and sufficient criteria for science. Modern approaches to the demarcation debate are not always construed in this way, and it would be a disservice to them to suggest that the only demarcation attempts made have been in such terms. As Massimo Pigliucci presents a response to Laudan's condemnation of the demarcation problem: "Demarcation should *not* be attempted on the basis of a small set of individually necessary and jointly sufficient conditions because 'science' and 'pseudoscience' are inherently Wittgensteinian family resemblance concepts" (2013: 25). One might reasonably treat the NOMA principle in such a manner, with the borders of magisteria being fuzzier than so far presented. However, in the context of the specific discussion of separation regarding the supernatural, it does not seem that such an approach properly reflects the history of the debate. We are discussing an area in which, implicitly or explicitly, 'supernaturalism' has been considered a sufficient condition for exclusion from science (or, alternatively, in which non-supernaturalism has been considered a necessary condition for inclusion in science). That said, the possibility of a more flexible approach to demarcation will be discussed in the closing chapter.

Finally, I must clarify that when I speak of 'compatibility' between science and the supernatural, this is not to say that scientific findings will be in accord with supernatural claims, but simply that science is capable of investigating them. As Lewis Wolpert describes the motivations behind creationism: "Scientific evidence is in direct conflict with the Scriptures. Humans, so science claims, are closely related to the apes, and women do not come from Adam's rib." (1992: 148). As we saw in the previous chapter, an abandonment of separationism may be of benefit to both

the advocate and the critic of supernaturalism. If a supernaturalist claim is correct, then I am arguing that the believer should be afforded the opportunity to demonstrate this scientifically. If it is incorrect, then the same opportunity should be afforded to their opponent.

With the goals of the following two chapters established, let us turn to the potential definitions of what it means for something to be called 'science'.

The content of scientific theory

Before discussing the relationship between content in science and the supernatural, we should first acknowledge a separate distinction that is often drawn between science and certain other disciplines. Though similarly hard to define, there is a commonly perceived divide between the 'sciences' and the 'humanities', as Hansson describes it:

Today, "science" refers to the disciplines investigating natural phenomena and individual human behaviour and to some of the disciplines studying human societies. Other disciplines concerned with human societies and culture are instead called humanities. Hence, according to the conventions of the English language, political economy is a science (one of the social sciences) but classical philology and art history are not. (2013: 63)

The vagueness of this distinction is reflective of the discussion regarding the definition of science in general. As Hansson himself argues, historically the term 'science' could have applied to a much broader category of activity, including that which now falls under the banner of 'humanities'. This is of particular importance to us because the term 'pseudoscience', rather than 'pseudohumanity', is often attributed to activities which would otherwise fall under the domain of the humanities, for example holocaust denialism (2013: 65).

Fortunately, although there is significant overlap between our present discussion and the demarcation debate, we are not burdening ourselves here with the task of

establishing a correct definition of 'pseudoscience'. It is not important to us whether holocaust denialism is rightly thought of as a pseudoscience, nor even whether or not creationism falls into that category. Rather, we are concerned with whether or not creationism might be considered a science. Given this task, we might ask ourselves what definition of science is being implied. Are we asking whether creationism is a science in the modern, narrow sense, or in the broader historical one?

Though the blurriness of the distinction between narrowly construed sciences and a broader set of activities including the humanities renders this question somewhat difficult to answer, we will be roughly assuming a narrower sense of the term for the purposes of this discussion. This is informed mostly due to context, with the most pressing issue being the discussion of creationism and its insertion into science classrooms, in which it would perhaps be even less appropriate to see a discussion of art history than a discussion of the Biblical account of the origin of life. This blurriness will become more pertinent in chapter six however where we will consider arguments from natural theology, which in a modern context would be more traditionally located in a philosophy classroom than one dedicated to science. We shall leave this consideration aside for now however, and focus instead on the content of more widely accepted scientific disciplines.

Natural Law

We saw in the previous chapter that Ruse and Overton argued that supernatural hypotheses and phenomena were excluded from scientific investigation because science makes reference to 'natural law'. According to Ruse's understanding of both science and religion:

Religion does not insist on unbroken law. Indeed, religious beliefs frequently allow or suppose events outside law or else events that violate law (miracles). Jesus feeding the 5,000 with the loaves and fishes was one such event. This is not to say that religion is false, but it does say that religion is not science. (1982a: 73)

This is certainly a *prima facie* plausible understanding of both science and, if not religion, then at least miracles. The feeding of the 5,000 is considered miraculous precisely because it seems to violate natural law, in this case the conservation of energy. It is worth remembering that not all events that are considered 'miraculous' feature such a violation, but in the interests of fully addressing potential conflicts we shall focus primarily on cases where a natural law is claimed to have been breached.

Although this understanding might be *prima facie* plausible, in order to make any real progress we will need to clarify exactly what we mean by 'natural law' and if it makes sense to discuss a 'violation' of such a law under any given definition. If, for example, we consider natural laws to be universal truths, then it makes no sense to speak of a 'violation'. If there exists a counterexample to any particular law, say the feeding of the 5,000 and the conservation of energy, then this example would be a *defeater* to the law, rather than a violation of it. Indeed, if we are to consider the possibility that miraculous events actually occur, then it seems highly questionable that any scientific evidence could point towards a universal law of which it could be a violation.

There have been many suggested accounts of both what natural laws actually are, and how we come to understand them. In order to address this particular issue fully we will need to investigate each in turn and assess whether any of them could be considered 'violable' and whether any phenomenon we consider to be supernatural could constitute a violation of such a law. Due to the scale of this discussion it shall be the focus of a later chapter, and thus we shall move on to other concerns for now.

The natural world

Related to, but distinct from, the idea that supernatural phenomena violate natural law, is the idea that supernatural phenomena lie beyond the natural world. This can be interpreted quite literally, with beings posited to exist 'outside' of the

spatiotemporal boundaries of our universe, or it can be interpreted in a more figurative sense, with supernatural phenomena lying outside of the 'world' of empirical science, as in this statement from the [American] National Association of Biology Teachers (NABT):

Explanations employing nonnaturalistic or supernatural events, whether or not explicit reference is made to a supernatural being, are outside the realm of science and not part of a valid science curriculum. Evolutionary theory, indeed all of science, is necessarily silent on religion and neither refutes nor supports the existence of a deity or deities. (National Academy of Sciences, 1998)

Of course, as we saw in the previous chapter, there are many reasons that a body such as the NABT might wish to make such a claim, especially when making specific reference to evolutionary theory. It is worth noting that this statement transitions seamlessly from "nonnaturalistic or supernatural" to "religion" when discussing that which lies outside of the domain of science. Indeed, the statement not only conflates these terms, but omits any definition for them. This supports my earlier suggestion that the literature has tended to treat the concepts of the supernatural and the religious with a great degree of interchangeability.

The fact that such definitions are omitted however, should come as little surprise. Although, as with science, we have a reasonable sense of those things we consider 'natural' (tables, elephants, atoms) and those which we consider 'supernatural' (ghosts, prophecies, spirits), we do not have terribly precise criteria for either of these categories. This problem is exacerbated by the fact that putative definitions for each tend to be framed in terms of the other. For example, as David Papineau summarises the views of self-proclaimed naturalists: "[R]eality is exhausted by nature, containing nothing 'supernatural', and that the scientific method should be used to investigate all areas of reality, including the 'human spirit'" (2007). We see that naturalism is understood to be the view that the natural world is all there is, there are no supernatural entities. However, once again we do not see any concrete definition of 'supernatural' presented, with the closest reference being a later comment on the potential for such entities to have causal efficacy:

After all, there seems nothing *a priori* incoherent in the idea of radically 'supernatural' events exerting a causal influence on ordinary spatiotemporal processes, as is testified by the conceptual cogency of traditional stories about the worldly interventions of immaterial deities and other outlandish beings. (Papineau, 2007)

We would not, I think, want to attempt to construct any definition for the supernatural using such a subjective notion as 'outlandishness', particularly in a world where modern science quite happily embraces the kinds of notions found in modern cosmology and quantum mechanics. Although we might be able to build such a definition whilst utilising 'immateriality', it will require significant expansion. We do not commonly consider abstract entities such as numbers to be 'supernatural' even on a Platonic account. Nor, I would argue, should we consider a dualist view of minds to be necessarily supernaturalist (even if we might consider it to be nonnaturalist). We shall discuss the notion of immateriality in further detail in chapter three.

As Papineau defines naturalism in terms of the rejection of supernatural entities, so do others define the supernatural in terms of the natural. Paul Draper posits that if an entity (x) is supernatural, then: "x is not a part of nature and x can affect nature" (2005: 277). Similarly, Pennock argues that: "The first and most basic characteristic of supernatural agents and powers is that they are above and beyond the natural world and its agents and powers. Indeed, this is the very definition of the term. They are not constrained by natural laws or chance processes." (2006: 471).

Not only do these definitions fail to present us with any more useful method for differentiating supernatural phenomena from natural ones, but Draper's latter observation, namely that supernatural phenomena "*affect* nature", actually highlights a further difficulty we have in doing so. If supernatural phenomena were understood to be outside of the natural world in the sense of being isolated from the causal mesh of our universe, then it would, at least in principle, be extremely easy to differentiate between the supernatural and the natural; we could simply point to those phenomena which fall outside of the causal mesh in which we find ourselves. As Papineau observed however, this is simply not a convincing account of what we

mean when we refer to supernatural phenomena. Most, if not all, posited supernatural entities demonstrate at least some causal relation to us simply by being observed, and many are thought to do significantly more than that. This point is especially forceful in light of the fact that creationists, who are positing a cause for the very existence of human life, are being excluded from science on the grounds of supernaturalism.

This inability to define the supernatural in isolation from the natural presents an extremely difficult challenge to separationists such as the NABT quoted earlier. We might, in other circumstances, have identified the natural world with that which can be investigated by science. However, if we are defining the natural as that which can be investigated by science, and the supernatural as that which is not natural, then to say that science cannot investigate the supernatural is just to say that science cannot investigate that which cannot be investigated by science. While this is of course true, and tautologically so, it carries no normative force whatsoever. Although separationism would be consistent according to such a definition, it would offer us no tools to differentiate between what can and cannot be investigated by science. We need, as we shall attempt to find over the course of this thesis, an understanding of supernaturalism which is independent of science, but which *also* precludes scientific investigation if a separationist position is to be held without circularity.

As well as being problematic in itself, considering the supernatural to lie outside of the natural world may, indirectly, undermine the idea we discussed earlier about such phenomena being violations of natural law. As we saw Plantinga observe in the previous chapter, natural laws are classically taken to operate within a closed system. In the case of natural laws, that system is the universe itself. As God lies outside of the universe, then it makes no sense to speak of Him as 'violating' those laws.

This understanding of God lying outside of the universe can avoid the notion of violating natural laws in three distinct ways. We might understand God, or some other extra-universal entity, as obeying natural law, but accept that the universe

does not represent a closed system. For example, whilst a pot of water is subject to the laws of thermodynamics, it is possible to increase the energy within that system by introducing an external heat source. Similarly, whilst it is impossible to increase the mass of a given body of loaves and fish (except under extremely unusual conditions) to the extent that one could comfortably feed 5,000 people, this is in no way a problem if we simply allow for an external source of the mass. The laws pertaining to the universe can be thought to hold in the same way as they do the pot of water. When no outside influences are affecting the universe, then we can expect the contents of the universe to behave in a certain way. When an outside influence is affecting the universe (for example, if God is intervening in some way), then we can expect the contents of the universe to behave differently, but still in accordance with natural law as applied to the larger system.

Alternatively, we might say that natural laws apply only to the empirical universe, but that those laws represent a special instance of more general laws. In this way, the laws of the universe relate to God in the same way that Newtonian physics relates to Einsteinian physics. The principles of relativity theory do not reflect violations of classical mechanics, but rather classical mechanics reflects the approximate instantiation of relativistic principles under specific circumstances. Similarly, natural laws may represent the instantiation of more general principles, whilst limited to a narrow range of conditions.

Finally, we might argue that natural laws are only those laws which apply within our empirical universe, but that our universe's laws represent only one set of laws among many. God, though subject to some set of laws (or not), is not subject to the laws that apply within our universe. However, as the laws of our universe are only thought to hold while the universe is a closed system, God's actions within our universe still do not constitute a violation of those laws, even though his actions are both (partially) within our universe and not in accordance with the laws that apply to it.

In each of these interpretations then, we see that there is no violation of natural law on God's part, however there are two important objections to note here in the context of the separationist debate. Firstly, that not all supernatural phenomena are obviously external to the closed system of the universe: ghosts, spirits, psychic phenomena and so on, albeit non-physical in a sense, do appear to exist 'within' the boundaries of the universe. Although one might argue that science can only investigate the physical universe, this seems unsupportable. If we suppose, for example, that a mental realm exists, then psychology serves as a fairly clear cut example of scientific investigation into it. The delineation between physical and non-physical in terms of scientific investigation thus seems arbitrary, at least in terms of distinguishing between supernatural and natural non-physical investigation. If there is an impediment to the scientific investigation of the non-physical, then this does not seem to hinge upon notions of supernaturalism.

Pursuant to this objection is the fact that, even supposing that supernatural entities do lie beyond the boundaries of a closed 'universe system', they quite clearly produce effects within that system. These effects, by virtue of existing within the universe, thus seem perfectly investigable by science, at least by the standards so far outlined. Even God, our paradigmatic example of an extra-universal entity, is thought to produce quite clearly intra-universal effects, including the existence of the universe itself. Creationists express no intention to investigate God directly, but rather posit God as an explanation for phenomena which biologists investigate as a matter of routine. Thus, whilst one may well wish to argue that science cannot investigate phenomena that lie beyond the boundaries of the natural world, this is not the kind of investigation being discussed by either the proponents of supernatural investigation or those opposing them. In other words, one cannot avoid this problem by appealing to the weaker form of separationism mentioned in the previous chapter.

As stated, we shall look further into the notion of supernatural phenomena as being violations of natural law in chapter four. We shall also address the notion of God, or any other phenomenon, lying outside of the universe in chapter six. For now

however, let us turn to one final aspect of our 'content' approach to categorising science: the use of mathematics.

Mathematics

Godfrey-Smith (2003: 10-11) argues that one potentially notable aspect of scientific theory, and in particular in the *success* of scientific theory, is the usage of mathematical tools in describing and predicting the universe. He bolsters this suggestion with a quote from Galileo:

Philosophy is written in this grand book of the universe, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and to read the alphabet in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures without which it is humanly impossible to understand a single word of it; without these, one wanders about in a dark labyrinth. ([1623] 1990: 237-38)

Although the charge of lack of mathematical rigour has not been overtly levelled against the investigation of the supernatural in the literature, this certainly captures some of the attitudes that we have seen during our discussion: the notion that science is systematic and objective, relying quite literally upon facts and figures, as opposed to the more 'mystical' and 'spooky' realm of supernaturalism. While this kind of distinction might seem superficially appealing, a mathematical approach seems to be neither necessary, nor sufficient, for the exclusion of the supernatural from science. As Godfrey-Smith observes regarding Darwin's *On the Origin of Species*, which is the antithesis of creationism, the arguments within the treatise do not rely heavily on mathematics, but we would surely not take this as reason to think it unscientific (2003: 11-12).

Conversely, there are many instances of supernaturalists employing almost exclusively mathematical arguments in advocating the existence of supernatural beings. This is seen prominently in the work of Intelligent Design theorists in their contention that the probability of life originating unaided is insurmountably low. As we shall discuss in chapter six, it is also seen in arguments regarding the 'fine-tuning'

of the universe which, although they are less frequently cited in cultural or philosophical discussion of the topic, bear a striking resemblance to both Intelligent Design arguments and those involved in at least some forms of multiverse theory.

One might argue that Intelligent Design theorists are not, in fact, utilising mathematics to establish the existence of supernatural phenomena, but rather doing so to undermine a naturalistic theory. Thus they are not practising supernaturalistic science, but simply naturalistic science. Even granting that their arguments *confirm* that a designer of life as we know it must exist, there is nothing to support the idea that this being must be supernatural in nature, with ideas such as panspermia providing a viable alternative hypothesis. This would align with the kind of 'weak' separationism discussed earlier.

However, as we shall again discuss in chapter six, Intelligent Design theorists, as well as defenders of other natural theological arguments, claim that there are reasons not simply to dismiss proposed naturalistic explanations, but to *posit* supernatural ones. Although the relationship between natural theology and science is a somewhat murkier discussion than other issues we shall consider, it is simply factually incorrect that supernaturalists have not employed mathematics to defend their positions. Thus we cannot justifiably exclude supernaturalist hypotheses from scientific investigation on the grounds that they are not spoken in Galileo's language of the universe; for one because this is not something we demand of scientific theories elsewhere, and for two because this is simply an unfair assessment of the state of the debate.

The methodology of science

The second of our potential categories for science is that of methodology. This is an extremely appealing category for demarcation in many ways, and we make frequent usage of the term 'scientific method' in everyday discourse on the subject. It is not

in practice, however, such an easy term to pin down. "Although describing a special scientific method looks like a natural thing to try to do, during the twentieth century many philosophers and others became sceptical about the idea of giving anything like a recipe for science. Science, it was argued, is too creative and unpredictable a process for there to be a recipe that describes it – this is especially true in the case of great scientists like Newton, Darwin or Einstein." (Godfrey-Smith, 2003: 7). As with our discussion of content let us again, rather than attempt to outline any concrete or accepted understanding of 'the scientific method', address some of the features which have been thought to comprise it, and potentially conflict with supernatural investigation.

Testability

To once again return to the criteria for science laid out by Ruse and Overton, we shall begin with their suggestion that a scientific hypothesis or theory must, at least in principle, be testable and falsifiable. As Ruse makes the point: "A genuine scientific theory lays itself open to check against the real world: the scientist can see if the inferences made in explanation and prediction actually obtain in nature" (1982a: 73).

As we saw in the previous chapter, Ruse considers the falsifiability criterion laid out by Karl Popper, to be a "rough and ready" approach. Popper's account is by no means uncontroversial, and shall receive a more thorough treatment, alongside several other of the methodological approaches to science, in chapter five. For now however, let us grant that science could, in principle, have a falsifiability criterion, and that any hypothesis or theory which does not satisfy it falls outside of the domain of science.

It is not obvious that even granting falsifiability as a criterion for science demands the exclusion of the supernatural. Many supernaturalistic claims have, at least by the standards adopted by a very general 'mainstream' scientific community, been both tested and satisfactorily falsified. As Hansson (2008) observes: "Astrology,

rightly taken by Popper as an unusually clear example of a pseudoscience, has in fact been tested and thoroughly refuted". One may adopt a similar position regarding creationism, as indeed Ruse himself seems to have: "I believe Creationism is wrong; totally, utterly, and absolutely wrong. I would go further. There are degrees of being wrong. The creationists are at the bottom of the scale." (1982b: 303).

Even though we can see that at least some supernatural claims are commonly held to be falsifiable, Ruse's criterion for science does not actually seem so strong as to demand it. The description of scientific standard outlined seems to simply require that there be some empirical support for a scientific claim, with a particular emphasis on prediction. However, predictive success does not imply that a theory is falsifiable. A successful prediction does not prove a hypothesis, because another incompatible hypothesis may make the same prediction, and a failed prediction does not disprove a hypothesis unless it is impossible for the hypothesis to be true and the prediction to fail, which will in practice never be the case due to the number of auxiliary assumptions involved in scientific testing.

This weaker standard might seem tempting when one thinks about theistic claims, in particular when one considers creationism. We simply cannot go back and check if God created complex life fully formed and, unlike naturalistic evolutionary theories, there is no reason to suppose any evidence in favour of such a hypothesis would obtain in the present day. Miraculous events, at least on a primary reading⁶, represent one-off interventions in the natural course of history, without any obvious method for scientific appraisal. As Stephen Schafersman argues: "If supernaturalism were true, miracles would allow unique, non-repeating, and non-controllable events to cause natural effects that would be incomprehensible using empirical methods of investigation" (1997).

Despite these concerns, I would argue that not only is such a criterion unreasonable as a basis on which to exclude the supernatural in general from science, but will not

⁶ The nature of miracles, and whether such an interpretation is appropriate will be discussed in chapter four.

even exclude creationism itself. Many apparently supernatural claims have obviously empirically testable elements ("Look, there is a ghost over there!"), including many relating directly to theistic doctrine. Although we might not expect there to be any evidence remaining from an act of divine creation, save perhaps for the absence of, for instance, transitional forms in the fossil record, we would most certainly expect to find evidence of a worldwide flood having occurred at some point in the past 6,000 years. As will become a repeated feature of our investigation, we find that although some specific supernatural phenomena may prove unable to admit of empirical testing, this is not a direct result of their supernaturality, but rather due to other factors.

To consider this point in terms of creationist doctrine, one of the most prominent arguments put forward by Intelligent Design theorists has been the notion of "irreducible complexity", first introduced by Michael Behe:

By *irreducibly complex* I mean a single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning. An irreducibly complex system cannot be produced directly (that is, by continuously improving the initial function, which continues to work by the same mechanism) by slight, successive modifications of a precursor system, because any precursor to an irreducibly complex system that is missing a part is by definition nonfunctional. An irreducibly complex biological system, if there is such a thing, would be a powerful challenge to Darwinian evolution. (1996: 39)

Although, as many have⁷, one might object to the notion that any example of such an irreducibly complex system actually has been demonstrated to exist, there is nothing in principle to say that such a system could not exist and be the result of a supernatural creator. More importantly however, such an objection says nothing as to whether or not a supernatural creator hypothesis, based upon irreducible complexity, is scientific on Ruse's standard. Let us now look at each of our interpretations in turn, as they raise different concerns.

⁷ As Judge John E. Jones concluded at *Kitzmiller v. Dover Area School District*: "We therefore find that Professor Behe's claim for irreducible complexity has been refuted in peer-reviewed research papers and has been rejected by the scientific community at large." (Monroe, 2012: 29).

Taking Ruse to be implying some variant of Popperian falsifiability, we can see that the previous objection actually *supports* the claim that irreducible complexity, and by extension Intelligent Design, can be scientific. If we take any particular system posited to be irreducibly complex and find that we can remove a part of it and still find a functioning system, then we have *falsified* the claim that the system was irreducibly complex. Thus by disproving the claim that a system is irreducibly complex, we have confirmed that the hypothesis met the scientific standard currently in question.

One might object that this claim has not falsified the existence of irreducible complexity, but merely falsified the claim that the specific system in question is irreducibly complex. Thus, whilst one can make falsifiable claims utilising Behe's concept, the proposition itself, and its implication that life requires a designer, is not falsifiable. This objection, however, is irrelevant to the question regarding separationism. The distinction is being drawn between two claims: "Some systems in nature are irreducibly complex, and require a supernatural designer" and "This particular system in nature is irreducibly complex, and requires a supernatural designer". According to this objection, whilst the latter of these claims is falsifiable, the former is not, and thus only the latter is scientifically investigable. However, *both* of these claims are supernaturalistic, and thus clearly the property of supernaturalism is not the determining factor in whether or not either claim is scientific. Rather, the former claim is simply an example of an unrestricted claim such as "There is a comet", and it is by virtue of this that the claim is rendered unfalsifiable (Martin, 2002).

Let us turn then to the second interpretation of Ruse's criteria, that of being open to empirical checking. It seems obvious that if we can falsify a claim that it is thus open to such checking, but there are two key issues that arise here. Firstly, whilst we might be able to falsify the claim that a specific system is irreducibly complex, it is not so clear that if we fail to do this we have therefore shown that the system *is* irreducibly complex. It will always be epistemically possible that some unknown function to a reduced system exists, and thus we could never actually confirm that

any irreducibly complex system existed. Once again, however, this objection is much more general to scientific enquiry, and the supernaturality of the claim plays no role in the difficulty posed.

The second issue that arises is slightly more problematic. Even if we grant that some system has been confirmed to be irreducibly complex, this does not necessarily imply that it is the result of supernatural intervention. Thus whilst we might accept irreducible complexity as a scientifically investigable phenomenon, there is no inherent supernaturality to this concept⁸, and therefore we can maintain a perfectly consistent weak separationist position by admitting that irreducible complexity is scientific, but maintaining that any hypotheses regarding a supernatural source of this complexity is not.

This approach is not, however, in line with Ruse's outline for how we should understand scientific investigation. Ruse makes no demand that a phenomenon should be directly observable or testable, which would prove devastating to a vast array of scientific theories, but only that testable predictions should be derivable from scientific hypotheses. As Laudan notes: "It is now widely acknowledged that many scientific claims are not testable in isolation, but only when embedded in a larger system of statements, some of whose consequences can be submitted to test" (1982: 17). Thus neither strong nor weak separationism can be justified on such grounds.

This, however, is exactly what irreducible complexity does. Whilst I do not wish to speak for Behe's motivation in arriving at the concept, we can quite comfortably presume (based on our discussion in chapter one) that much of the Intelligent Design movement has been forwarded as an attempt to make religious claims scientific. This means that Intelligent Design theorists are positing that if a supernatural creator of complex life exists, then there will be evidence of design in that life, with

⁸ As we saw in the previous chapter, removing supernatural elements from the claims made in opposition to evolution was a driving force behind the shift from creationism to creation science and Intelligent Design.

irreducible complexity being a posited example of such evidence. Thus the existence of irreducible complexity in life represents *exactly* the kind of predictive claim that Ruse is demanding, and it is a prediction based on a supernatural hypothesis.

Before moving on to our next methodological description of science, it is worth noting here that not only are we unable to utilise untestability as a method for excluding the supernatural from science, but we are also unable to use it as a means of defining supernaturalism itself. We saw earlier in the chapter that attempts to define the supernatural in terms of that which is not natural leads to circularity, and although we might simply stipulate that the supernatural is that which cannot be investigated by science, we would then be unable to justify the exclusion of any phenomena from scientific investigation solely on the grounds of supernaturalism. However, if we take science to necessarily involve testability, then we encounter a further problem as untestability is not limited to phenomena that we wish to refer to as supernatural.

Perhaps the most famous example of an untestable object is Russell's teapot: "If I were to suggest that between the Earth and Mars there is a china teapot revolving about the sun in an elliptical orbit, nobody would be able to disprove my assertion provided I were careful to add that the teapot is too small to be revealed even by our most powerful telescopes" (1952: 547-548). This presents a clearly untestable phenomenon, but unless we wish to commit ourselves to referring to this teapot as being in some way supernatural, then we cannot commit to both a necessary testability criterion for science and a definition of supernaturalism which refers solely to that which cannot be scientifically investigated.

Explanation and prediction

Perhaps, rather than focusing on the testability aspect of Ruse's criteria, we might instead focus on the explanation and prediction. If we return to the idea that supernatural phenomena are in some way unbound by the laws of nature, then we

may conclude that this renders them necessarily unpredictable. As both making and testing predictions constitutes a large part of scientific method, we might thus be inclined to reject the supernatural on this basis.

Again, I do not wish to delve too deeply into the question of whether or not such a criterion is actually a requirement for science, but it is worth noting that such a condition could potentially pose problems for several phenomena which we would like to investigate scientifically. One-off occurrences such as the Big Bang and the origin of life, and arguably unpredictable phenomena such as some of those seen in chaos theory and quantum mechanics all pose problems for an account of science that demands predictability, yet we would not consider these phenomena to be beyond scientific appraisal. Instead we make inferences regarding these phenomena, and attempt to investigate them with whatever degree of predictability we can attain.

Moreover there does not seem to be any obvious reason to assume that those phenomena we commonly consider to be supernatural should be unpredictable. Indeed, without submitting such phenomena to scientific testing, how could we possibly determine that they did not conform to any predictable laws, natural or otherwise? What is there in our understanding of ghosts or deities that demands that they should act entirely erratically — or erratically at all? Even supposing that some aspects of 'supernatural' phenomena will forever remain beyond our comprehension, it does not then follow that no aspect of those phenomena should be subject to scientific enquiry. Surely we would need to do much scientific investigation of these phenomena before we could ever make such a strong claim as to deem them not just unpredictable in practice, but in principle?

For centuries scientists have recognized a difference between establishing the existence of a phenomenon and explaining that phenomenon in a lawlike way. Our ultimate goal, no doubt, is to do both. But to suggest... that an existence claim is unscientific until we have found the laws on which the alleged phenomenon depends is simply outrageous. Galileo and Newton took themselves to have established the existence of gravitational phenomena, long before anyone was able to give a causal or explanatory account of gravitation. (Laudan, 1982: 18)

Even if we disregard such considerations, and take Ruse and Schaferman's criteria to reflect requirements for being science, it is not obvious that the supernatural phenomena with which we are familiar fail to meet such conditions. The previous discussion of irreducible complexity, as well as cosmological and fine-tuning arguments, hinge on the idea that acts of a transcendent creator *do* offer explanatory power. Even the more fantastical tales of ghosts and ghouls do not display any obvious traits of unpredictability, with such phenomena behaving largely as one would expect any other creature to, albeit non-corporeally. Moreover what, if anything, could better reflect an example of testable and predictable claims than those made by astrologists and psychics⁹?

Although we might argue that supernatural phenomena could offer explanatory power, we saw in the previous chapter that many supernaturalists actually reject such an understanding. For example we heard from Chief Rabbi Sacks arguing that religion is about interpretative, rather than explanatory, understanding of the world around us. This may very well be true, and we shall discuss the idea that an explanatory approach to an understanding of religious claims is misguided in chapter seven. However whilst a religious person, speaking in a particular religious context, may well be disinterested in discussing God as an explanation for the universe, this in no way prevents anyone else from approaching the topic from that perspective. We can grant Lennox's argument that science cannot investigate *why* Aunt Matilda baked the cake, without having to grant that they cannot investigate *if* she made it. That religion is focused on the former question in no way suggests that science must therefore ignore the latter.

Methodological naturalism and explanation

Rather than argue that supernatural phenomena cannot be understood as scientific explanations, we might argue that there are reasons that we should exhaust all

⁹ This is approaching the issue from a theoretical perspective. In practice, the vagueness of the claims made may render them untestable, although this has nothing to do with the supernaturality of the phenomena in question.

possible naturalistic explanations *before* positing supernaturalistic ones. I will discuss three such arguments here, though the first two shall be treated as a pair.

The first argument for adopting methodological naturalism before looking for supernaturalistic explanations is that we have good inductive reasons for thinking that a naturalistic explanation will be found. This argument appeals to the historical success of such explanations, and an interpretation of the history of science whereby scientific understandings of, say, earthquakes, have replaced supernatural ideas. In that particular case the discovery of plate tectonics overturning notions of angered deities. I will not discuss the accuracy of such a historical interpretation here, though the popular impression of scientific discoveries conflicting with and usurping religious understandings is by no means uncontroversial. As Gary Ferngren argues:

[T]he growing recognition among historians of science [is] that the relationship of religion and science has been much more positive than is sometimes thought. Although popular images of controversy continue to exemplify the supposed hostility of Christianity to new scientific theories, studies have shown that Christianity has often nurtured and encouraged scientific endeavour, while at other times the two have co-existed without either tension or attempts at harmonization. If Galileo and the Scopes trial come to mind as examples of conflict, they were the exceptions rather than the rule. (2002: ix)

The second argument for adopting methodological naturalism for as long as possible is that supernaturalistic explanations represent 'science stoppers'. This is the idea that supernatural hypotheses, by virtue of lying beyond scientific testing, and offering no predictable implications, put a stop to any further scientific investigation. As Plantinga describes the problem: "How does it happen that there is such a thing as light? Well, God said, 'Let there be light' and there was light. This is of course true, and of enormous importance, but taken as science it isn't helpful; it doesn't help us find out more about light, what its physical character is, how it is related to other things, and the like." (1997: 152).

Although both of these arguments might support an initial methodological naturalism and, perhaps, support the notion that a supernatural explanation is *unlikely*, neither seem to suggest that a supernatural explanation could never be

acceptable. We might, based on the first argument, wish to say that we would never reach a stage in practice where we would be justified in accepting a supernaturalistic explanation, as there may exist an unknown naturalistic explanation. However, even accepting this conclusion, there is no reason to infer from this that supernaturalistic explanations are unscientific, for one could equally claim this about any number of naturalistic explanations which are also deemed unlikely. It is hard to imagine, given our current knowledge, a situation whereby we accepted a theory of combustion that relied on the existence of phlogiston, but this by no means suggests that phlogiston-based theories lie beyond the scope of scientific procedure.

Moreover, one might argue that these arguments misunderstand supernaturalist claims. In Plantinga's example regarding the origin of light, God is being treated as a temporally prior cause to the existence of light, effectively 'flicking the switch' and then playing no further explanatory role; He is only being posited as a last resort once all of the alternative avenues of investigation have been exhausted, filling in the gaps where naturalistic science has failed to find a solution. However, neither of these modes of thought adequately reflect the attitudes of a theistic belief in God, nor the theistic understanding of God's relation to the universe¹⁰. As Plantinga goes on to argue: "The Christian community knows that God is constantly active in his creation, that natural laws, if there are any, are not independent of God, and that the existence of God is certainly not a hypothesis designed to explain what science cannot" (1997: 150).

Plantinga does, however, acknowledge a third potential argument for methodological naturalism, derived from the work of Pierre Duhem: "If theoretical physics is subordinated to metaphysics, the divisions separating the diverse metaphysical systems will extend into the domain of physics. A physical theory reputed to be satisfactory by the sectarians of one metaphysical school will be rejected by the partisans of another school" ([1906] 1991: 10-11). In other words, science would not be able to function if everyone involved in it brought disparate

¹⁰ I will discuss religious attitudes towards the relationship between science and religion in chapter seven.

metaphysical assumptions to the table when assessing a hypothesis. Plantinga responds to this argument by suggesting that we distinguish between two forms of scientific practice: Duhemian science where everyone works under the same metaphysical framework, and non-Duhemian science where smaller groups can practice scientific enquiry according to their own metaphysical structures. This is a suggestion that will require further discussion later in the chapter when we discuss the social structure of science, but while we are on the subject of metaphysical assumptions, this is a useful juncture to briefly discuss anti-realist approaches to science.

Anti-realist approaches to science and the supernatural

We are, for the purposes of this discussion, assuming that science aims to capture 'truth' or, perhaps less ambiguously, that scientific theories in some way correspond to reality. Without this assumption it is difficult to see in what way science and religion could be thought to conflict. If the theory of evolution is not thought to describe a real history of the world then it is impossible for it to contradict with creationist doctrine which is also being understood in this fashion (for which reason we must also assume that supernaturalist claims are thought in some way to correspond to 'reality'). That said, the language and concepts we associate with the supernaturalist debate have echoes of the debates over 'unobservables' in discussions of scientific realism. Although the notion of scientific realism is somewhat broad, we shall roughly understand it as the notion that science is able to make claims regarding the existence of unobservable phenomena. As Michael Devitt defines the concept:

Scientific realism: Most of the essential unobservables of well-established current scientific theories exist mind-independently. (2008: 225)

Though it would be imprudent to suggest that this definition covers the entirety of thought on the subject, it serves as a sufficient illustration for our purposes. What is important to our discussion is not the specific terminology involved in defining

realism, but rather the shared emphasis on observable and unobservable aspects of reality. As Richard Boyd summarises:

[M]ost define scientific realism in terms of the truth or approximate truth of scientific theories or certain aspects of theories. Some define it in terms of the successful reference of theoretical terms to things in the world, both observable and unobservable [...]. Others define scientific realism not in terms of truth or reference, but in terms of belief in the ontology of scientific theories. What all of these approaches have in common is a commitment to the idea that our best theories have a certain epistemic status: they yield knowledge of aspects of the world, including unobservable aspects. (2011)

Although we have not encountered an explicit definition of the 'supernatural' that relies on supernatural phenomena being unobservable, I do not think it a stretch to draw a connection here. Particularly in the area of theism, the literature frequently brings the two into comparison, if not implicitly conflating them:

We should not suppose that the problem with predictive expansion, as it pertains to purported supernatural explanations, lies merely in the fact that God, as a supernatural cause, is in principle unobservable. (Corner, 2007)

In both the dispute over the unobservable entities posited by scientists and the dispute over whether there is a God, there is, of course, an agnostic position, namely suspending judgement. (Forrest, 1996: 2)

There is not space here for a thorough treatment of the debate over scientific realism, though we will encounter some overlapping issues with regard to inferences to best explanation in later chapters. To briefly summarise, we might defend realist supernaturalistic explanations in science in the same way that a defence of a realist view of electrons might follow from the aptly named 'no-miracles' argument forwarded by Hilary Putnam: "Realism is the only philosophy that does not make the success of science a miracle" (1975: 73). Of course, such an argument could only apply if supernatural hypotheses served to provide similar predictive success as those regarding electrons.

Alternatively, as we shall discuss in chapter six, many of the arguments on what we might consider the borderlines between science and religion may be understood to be structured in the form of inferences to best explanations, rather than the kind of

testable hypotheses we might see in a hypothetico-deductive model. Indeed, we have seen the beginnings of this discussion in our earlier overview of creationism and its inference to a designer from observations in the natural world. Later we shall see this in arguments from fine-tuning, as well as anti-supernaturalist arguments such as the evidential version of the problem of evil. We might therefore be able to argue that if science can utilise such inferences in naturalistic hypotheses, then it could do the same for supernaturalistic ones.

Inferences to best explanations have not been without controversy. Bas Van Fraassen, a notable critic of scientific realism, has argued that even if we grant that inferences to best explanations are a worthy rule of inference, then the realist still requires an extra premise in order to defend their position, namely that we need to be committed to one of a range of hypotheses being true. However there is no requirement, in van Fraassen's view, that we should make such a commitment: "I am committed to the view that T is true or T is false, but not thereby committed to an inferential move to one of the two! The rule operates only if I have decided not to remain neutral between these two possibilities." (1980: 22).

In contrast to the realist view, van Fraassen argues for 'constructive empiricism', the view that: "Science aims to give us theories which are empirically adequate; and acceptance of a theory involves as belief only that it is empirically adequate" (1980: 12). Here, a theory is empirically adequate if the claims it makes regarding observable entities are true, but this need not be the case for the unobservable ones, if any such entities do indeed exist. Thus whilst we might consider an inference to the existence of some unobservable entity to be the best explanation for the truth of our observations, we are not committed to such reasoning. So long as the theory is empirically adequate regarding observables, we need make no inferences regarding its non-observable content.

In the context of our discussion, we are assuming that science makes claims regarding unobservables which are in fact true, or at least are intended to be regarded as true. However, we might be inclined to adopt a weak separationist

position on similar grounds to van Fraassen. We can commit to the truth of scientific claims regarding observable (natural) entities, without having to accept that science makes truth claims regarding unobservable (supernatural) entities. The NOMA principle here can be read to indicate that science can make truth claims regarding the natural realm, but not the supernatural realm, in the same way that it can make truth claims about the observable effects of combining sodium chloride and silver nitrate, but not about the supposedly underlying interactions between particles posited by chemists to explain those effects. If no truth claims are made regarding the supernatural realm by scientists, then there can be no conflict, and indeed no interaction at all, between science and supernaturalism. This echoes the work of Duhem, who wrote in 'Physics of a Believer' that:

[M]etaphysical and religious doctrines are judgments touching on objective reality, whereas the principles of physical theory are propositions relative to certain mathematical signs stripped of all objective existence. Since they do not have any common term, these two sorts of judgments can neither contradict nor agree with each other. ([1906] 1991: 285)

While this might make some sense of the NOMA principle, it suffers from several major flaws in the context of our discussion. Firstly, from a normative perspective, we simply cannot justify applying a separationist position in any kind of legal capacity by such an appeal. Van Fraassen's constructive empiricism, or any form of anti-realism, has gained nowhere near enough support within the philosophy of science (let alone the scientific community) to warrant the kind of exclusionary policies at hand. Although we cannot dismiss the possibility that anti-realism is indeed a 'correct' approach to science, and perhaps will one day be a prevailing viewpoint, it is not the case *at present* that anti-realism is successful enough to stand as a basis for the exclusion of creationism from science.

More problematically, and more fundamentally, the separation between science and religion affected by the debate between realism and anti-realism doesn't depend on anything to do with the supernatural. Whether or not science can investigate unobservables is an issue which has bearing on whether or not science can investigate supernatural phenomena, but it does not do so by virtue of them being

supernatural. Thus, while this is an interesting issue, it isn't relevant to the subject of discussion at hand. Even if it were, the adoption of anti-realism seems a high price to pay in order to avoid perceived conflict between science and the supernatural.

Finally, while an anti-realist approach to the supernatural in science cannot conflict with a realist approach to the supernatural, it would be wrong to summarise the anti-realist position as analogous to the kind of exclusion being forwarded by separationists. Separationists have not just argued that science makes no claims regarding the truth of supernaturalist or religious claims, but that supernatural or religious hypotheses can play no role in scientific theory outright. This is equivalent not to saying that we should remain agnostic regarding truth claims concerning electrons, but to saying that electrons should not appear at all anywhere in scientific theory. Clearly this is a significantly stronger, and significantly less palatable, claim. If supernaturalist theories provided the kind of 'empirical adequacy' that van Fraassen is seeking, then agnosticism regarding their truth value does not prevent them from playing a role in scientific theory.

Tentativeness and Integrity

In his commentary on the Arkansas case, Ruse argues that science differs from both philosophy and religion because scientific theories are adjusted in the light of new empirical evidence: "Scientists differ from both the philosophers and the theologians. Nothing in the real world would make the Kantian change his mind, and the Catholic is equally dogmatic." (1982a: 73). I would like to address this issue in two different ways, firstly on the assumption that Ruse is correct in his claim that science is necessarily free from dogmatism, and then by asking whether this assumption is a warranted or even desirable one.

Let us assume then that Ruse is correct. As Judge Overton argued in the Arkansas trial: "A theory that is by its own terms dogmatic, absolutist, and never subject to revision is not a scientific theory" (Dorman 1996). I will not deny that if this

summary is accurate then religious fundamentalism may indeed be regarded as unscientific for precisely these reasons. Nor will I deny that a great many of the prominent creation scientists or Intelligent Design theorists fall into exactly this category regardless of any pretensions to performing open-minded enquiry. What I will argue however, is that this conclusion fails to undermine the status of creationism as science, let alone undermine the status of supernatural claims in general.

Firstly it must be noted that a lack of tentativeness is not a defining characteristic of all creationists. As Stephen Jay Gould observed: "Creationists have tightened their act. They now argue that God only created 'basic kinds', and allowed for limited evolutionary meandering within them." (1983: 257). Now it should be made clear that Gould was not defending creationism here, and was in fact one of its strongest opponents, but this point does show that on some level creationists are willing to adapt their ideas in order to deal with overwhelming scientific opposition. Perhaps not enough to be deemed scientific by the standards Ruse and Overton intended to imply, but they are capable of adjusting their position, at least to a small degree.

Although this may seem a trivially small concession, absolute tentativeness is not a defining characteristic of the majority of accepted scientists. As Laudan observes: "Are quantum mechanics willing to contemplate giving up the uncertainty relation? Are physicists willing to specify circumstances under which they would give up energy conservation?" (1982: 17). Indeed, in *Darwinism Defended*, Ruse himself argues that: "evolution is fact, *fact*, FACT!" (1982b: 58, emphasis as original). Even if one defends the idea that scientists in general are willing to give up their most ardently defended beliefs more easily than creationists, it is not so clearly a distinguishing feature of 'genuine' science as seems to be implied. Absolute tentativeness thus seems a poor basis on which to argue that creationism is unscientific, but any lowered standard of tentativeness is one that creationists may already have passed.

There is a related issue with this type of objection to creationism that should be addressed now as it pervades the discussion, and that is the accusation that creationists are not scientists because a necessary feature of a scientist is *integrity*. As Ruse scathingly claims: "Creation scientists use any fallacy in the logic books to achieve their ends. Most particularly, apart from grossly distorting evolutionists' positions, the creation scientists frequently use inappropriate or incomplete quotations." (1982a: 76). Generalisations aside, I do not believe that Ruse is being particularly unfair here. For example, Ben Stein's 2008 film *Expelled: No Intelligence Allowed* presented numerous inaccuracies regarding both evolution and the debate in order to make its point. This included incomplete accounts of personal stories to suggest that anyone in the scientific community who voices sympathy for Intelligent Design is immediately ostracised, with selectively edited interviews (including with Dawkins himself) to suggest that the interviewee might support Intelligent Design, and even editing a passage from Darwin's *On the Origin of Species* in order to imply a direct link between Darwin's views, Nazism and eugenics (Mirsky, 2008).

Although these actions by the makers of *Expelled* seem quite clearly to lack the sort of integrity Ruse suggests is required of science, it should also be clear that even this anecdotal evidence is a reflection on specific supporters of creationism, and not creationism itself. We saw in the previous chapter that much of the discussion over supernaturalism in science has been muddled by other factors and that it is the aim of this thesis to try to extract those issues from the discussion. However, we must take care not to eliminate theories or entire ontologies from science solely on the grounds that some or even all of their proponents have been seen to act without integrity. Moreover, as I noted earlier in this chapter, while it would seem at least instinctively inappropriate to class scientific fraud as pseudoscience, it would *certainly* be inappropriate for scientific fraud to render the field in which it occurs pseudoscience. One person intentionally misrepresenting geological data is no reason to class geology as a pseudoscience¹¹. In the same way it is inappropriate to reject creationism as science because of the actions of specific creationists.

¹¹ Ironically enough, some ID proponents still (misleadingly) cite the infamous case of 'Haeckel's embryos', in which Darwin unknowingly used falsified evidence for evolution as support for his

If neither integrity nor tentativeness are an appropriate criteria for excluding the supernatural from science, on the grounds that it seems perfectly possible for supernaturalists to demonstrate these qualities to the same degree as any other practitioner of science, then it would seem prudent to move on at this stage. However, as I noted at the start of this section, one might argue that actually tentativeness is *not* a desirable criterion for science. If this is the case then even if supernaturalists were inherently incapable of tentativeness, either through dogmatic commitment to religion or for any other reason, then even this would not necessarily force their exclusion.

We saw earlier in the chapter that there are arguments in favour of 'methodological naturalism' in science. Specifically we saw that we have inductive reasons for believing that for any given unexplained phenomenon, we should suppose its explanation to be natural and thus aim to exhaust naturalistic explanations before looking for supernaturalistic ones. Here we see an argument that actively *discourages* tentativeness in scientific practice, instead endorsing the assumption of naturalism until it is no longer possible to do so. Indeed, Kuhn argued that in periods of "normal science", scientists should not question any of the central tenets of a theory: "On the contrary, when engaged with a normal research problem, the scientist must *premise* current theory as the rules of his game" (1974: 801).

One might extend this argument and suggest that naturalism, in modern Western science, represents a kind of Kuhnian paradigm. In which case, again, tentativeness regarding supernatural phenomena is entirely within the scope of legitimate scientific methodology. However, one must be careful in doing so, and moreover, one must be honest about it. Kuhnian paradigms are not understood as merely pragmatic assumptions, but rather as prevailing scientific theories which, in the context of this thesis, are to be taken as attempted approximations of 'truth'. Prior

theory, as a justification for writing off evolution: "Haeckel's embryos seem to provide such powerful evidence for Darwin's theory that some version of them can be found in almost every modern textbook dealing with evolutionary theory [...]. Although you might never know it from reading biology textbooks, Darwin's 'strongest single class of facts' is a classic example of how evidence can be twisted to fit a theory." (Wells, 2000: 82-83).

to relativity, conformance to Newtonian mechanics was not a mere practical assumption made for the purposes of efficient scientific methodology, but rather taken to accurately describe the nature of reality. Interpreting naturalism as such a paradigm would then not be a determination that supernaturalism was not part of science, but rather that supernaturalism was *false*.

The notion that supernaturalism is, in fact, false is often flirted with in the literature but not made explicit. As Pennock argues:

Take the geocentric view of the world, which is still advanced by some creationists. While one may say that such a claim was historically scientific or even that it remains scientific in the abstract sense that it is testable, it would nevertheless be fair to conclude, because this claim has been decisively disconfirmed (at least under the assumptions of MN), that it is unscientific to continue to hold and teach it today. The scientific picture of the world does not include claims that have been decisively refuted and effectively relegated to the dustbin of scientific history. (2009: 557)

Pennock argues that creationist claims share this feature, and thus should not be considered "scientific" for the same reasons. While this may, defensibly, be a charge laid against the specific claims made by creationists to date, it does not seem to be a charge generalisable to creationism itself, and certainly not to the supernatural as a whole (which with the limiting "under the assumptions of MN", Pennock seems to acknowledge). Indeed, the idea that supernaturalism, and even creationism in particular, are comparable to geocentrism, is a claim that would be taken by many as a deeply offensive notion. Of course, offensiveness here has no bearing on whether the comparison is valid.

We might grant that creationism shares the same empirical credibility as geocentrism, and for this reason is "unscientific" in a relevant sense. But even if this is the case, then considerations of non-overlapping magisteria, scientific method, natural law, supernaturalism and all of the other baggage associated with the debate are utterly irrelevant. Creationism, according to Pennock's suggested conception of "unscientific", is not unscientific because it is supernaturalistic, but rather it fails to be science because it is false. The supernatural separationist debate, and even the

more general demarcation debate which Pennock was attempting to address, have no bearing on this whatsoever.

What we can draw from these considerations is that one cannot dismiss supernaturalists from science for their lack of tentativeness, because a lack of tentativeness, particularly regarding core assumptions, is entirely consistent with scientific practice. Moreover one cannot attempt to reframe the dismissal in terms of tentativeness regarding matters which are contrary to the dominant paradigm of the time. If one does so, then one is not saying that supernatural claims are not scientific because they are supernatural, but rather that they are not scientific because the scientific community considers them not to be true.

Given that a scientific consensus that supernaturalism was false would not be consistent with the notion of exclusion from scientific investigation that we are discussing, I shall not pursue this line of thought any further. For the purposes of this thesis, a scientific conclusion that supernaturalism was false would constitute supernatural investigability by science. It would also be entirely in opposition to the idea of "respectful discourse" to which Gould appealed in defending his NOMA principle (1997: 62). Bearing that in mind, this should not be confused with scientists as a community who happen to believe supernaturalism was false for other, non-scientific reasons (for example emotional, philosophical, or aesthetic ones). This distinction brings us to the final of our three main categories of what science is: social structure.

Science and social structure

While we have spoken of the content of scientific theories and the methodology used to arrive at them, it is important to remember that 'science' is not an independent force or entity existing in isolation from those who engage in it. Without scientists, there would be no science. Throughout this discussion we have

compared science to other kinds of human activity and investigation, notably to religious, philosophical and 'pseudoscientific' endeavours. Perhaps then we might best understand what it is to be scientific by considering the ways its practitioners interact with each other. As Steven Shapin argues, scientific knowledge is more than just the aggregate knowledge of those we call scientists; without the trust and cooperation of those who have scientific knowledge it would be impossible for scientific progress to move beyond that of the knowledge of an individual:

Take any practical action or cultural move in science; then imagine that all trusting relationships were canceled. Consider the void that would be left. Our prevalent understanding of science – though not, of course, science itself – is thus deeply paradoxical. We traditionally and formally warrant scientific truth by pointing to individual empirical foundations, yet nothing recognizable as scientific knowledge would be possible were that knowledge actually to be individually sought and held. (Shapin, 1994: 27)

There are a number of ways in which we might interpret science as reliant on social structure. Firstly, as Shapin has done, we could do so in a way that treats the social structure as an integral part of the epistemic justification. Indeed, the concept of 'peer review' as a strength of science and academia in general is something I would consider not only uncontroversially a strength, but also relatively uncontroversially an absent feature of many of the pseudosciences. As Martin Mahner notes:

Dowsers share some information, but most have their own private theories about the alleged laws and mechanisms of dowsing [...] there is no general theory shared by a community of dowsers, no mutual evaluation methods and theories, no collective mechanism of error correction, and so forth. So the lack of a research community is a clear indication that what these people do is not a science. (2013: 38).

Mahner observes that whilst the dowsers do not share the kind of communal mechanisms shared by legitimate scientists, creationists in a sense do. "For example, creationists organize congresses and publish their own peer-reviewed journals" (2013: 42). However, he argues that these activities are isolated from other research communities, and thus creationism constitutes an independent entity, rather than "a proper subcommunity of the international scientific community" (2013: 42). While this is an interesting and plausible criticism, it is, as with tentativeness and integrity,

wholly tangential to the issue of supernaturalism. That creationists are not a proper part of the scientific community currently is not to say that they never could be. Indeed, given the prevalence of separationist attitudes within the scientific community, it is actually somewhat difficult to blame the creationists for their own isolation.

Alternatively, we might consider the notion that 'what science is' is determined socially, by the consensus of those we consider scientists, or simply as a matter of wider cultural language norms. As Godfrey-Smith observes:

Some writers use terms like "science" or "scientific" for any work that assesses ideas and solves problems in a way guided by observational evidence. Science is seen as something found in all human cultures, even though the word is a Western invention. But there are also views that construe "science" more narrowly, seeing it as a cultural phenomenon that is localized in space and time. For views of this kind, it was only the Scientific Revolution of the sixteenth and seventeenth centuries in Europe that gave us science in the full sense. (2003: 4)

These views are not mutually exclusive, but offer us differing ways to approach the problem. If we accept the latter approach, then it may simply be true by consensus that supernatural phenomena are not a part of science. We saw in the previous chapter that legal decisions have tended to conclude that this was the case, as have various scientific and educational organisations such as the National Association of Biology Teachers mentioned earlier in this chapter. Could it be that the conclusion of those courts was valid not because the courts had understood the 'true' nature of science, but instead because their decision rendered the nature of science to be so?

Although this understanding might put us in a position to say definitively that supernatural phenomena are not within the domain of science, it does not seem a particularly satisfying answer. Supernatural phenomena are excluded here for no other reason than because it has been decided by some people that this should be the case. Moreover, if science is interested in seeking truth, as we are supposing it to be, this move would arbitrarily delineate between truths that science can reach, and those that it cannot. Surely we want to say that science is special in some way, that there is something *about* science that makes it so successful in truth seeking,

and that those things which are not considered science are excluded on the basis that they do not exemplify this property. That the supernatural is excluded from science by mere consensus rather than argument seems to be at best a hollow victory for the separationist.

Even more problematic for such a position is that even if such a consensus exists, it is a relatively recent one. As Richard Noakes observes:

Recent scholarship has rightly argued that since the Victorian period witnessed such fierce scientific, intellectual and theological debates over the boundaries between science and Spiritualism, science and pseudo-science, we cannot take such boundaries for granted in our historical analyses. These boundaries are the *explanandum not the explanans*. One of the most important benefits of this scholarship is that it draws attention to the complexity of the debates out of which these boundaries emerged and shows that controversies over Spiritualism were not, as traditional historiography suggests, struggles between proponents of 'science' and 'pseudo-science', but fights between individuals who disagreed on what counted as the proper scientific approach to the spirit world. (2004: 24, emphasis as original)

While it is of course possible that a modern consensus that science cannot investigate the supernatural represents academic progress, this would be a claim that requires defending. Indeed, it is also the very claim that this thesis seeks to undermine. If the separationist can rely on neither argument nor tradition to support their view, then it seems that this approach collapses into mere collective assertion. Moreover, if we do accept those views identified by Godfrey-Smith which take science to be a "cultural phenomenon that is localized in space and time", and also accept Noakes' account of the Victorian approach to spiritualism, then this seems to entail that there are times when science *can* investigate the supernatural.

Turning then to Shapin's interpretation of the relationship between social structure and science, we can consider the notion that "trust" might be this special property which differentiates science from non-science. Or, at the very least, that it constitutes a necessary property of what it is to be scientific. As we have discussed, Ruse argues that "integrity" was a necessary part of the scientific enterprise and that, whilst individual scientists might sometimes act fraudulently, the scientific

community as a whole requires honesty to function. "Good science – like good religion – presupposes an attitude that one might describe as professional *integrity* [...]. Science depends on honesty in the realm of ideas" (Ruse, 1982a: 74, emphasis as original).

We have seen in our discussion of the history of *Of Pandas and People*, and in the *Expelled* movie, that creationists are not entirely innocent of dishonest behaviour. However, even granting that honesty and integrity are essential to science, and granting even further that no creationist anywhere possesses honesty and integrity (a ludicrous claim), we would still only be able to determine that creationists are not scientists, not that creationism was not scientific. We thus see no more reason here to exclude creationism from the domain of science (let alone the supernatural in general) than we would to exclude quantum physics if all of the quantum physicists in the world were suddenly rendered pathological liars. As Laudan argues: "What counts is the epistemic status of Creationism, not the cognitive idiosyncrasies of the creationists" (1982: 17).

Shapin's notion that trust is an integral part of science does not seem therefore to conflict with the possibility that supernatural phenomena might be considered within the domain of science. That creationists fall outside of the social structure of science says nothing against the possibility that those within that social structure might discuss creationist topics scientifically. Indeed, it is *because* the ideas of creationists *have* been discussed within the social structure of science that the scientific community has been able to reject them.

There is a third way that we might understand the relationship between science and social structure that we should consider, that of the 'goals' which scientists aim to achieve. However, unlike our currently painted picture of science, the supernatural does not reflect a body of people, and is instead a putative characteristic of a certain group of phenomena. In order to meaningfully differentiate between science and supernatural investigation on the grounds of 'goals', we need to turn to organised and normative structures revolving around supernatural beliefs. This brings us

neatly, and unavoidably, to the subject of religion. Before discussing whether or not science and religion *do* differ in goals however, we should first discuss the definition of the supernatural more fully. We shall thus return to both of these points in the following chapter.

Conclusion

This chapter has raised multiple possible conceptions of what it is for something to constitute science. These lists are neither exhaustive in scope, nor do they expound upon all of the particulars of each conception listed. What I have provided here is rather an overview of the most prominent potential avenues one might pursue in order to forward a separationist position. I make no comment here as to whether or not any conception is better justified, or more promising than any other, but rather offer them all as viable candidates for the source of incompatibility currently in question.

We have discussed three broad areas by which we might demarcate science: content, methodology, and social structure. In the first category we saw that potential incompatibility between science and the supernatural may arise either through the concept of natural law, the natural world, or mathematics. The first two of these conceptions will require significantly more analysis, and will be discussed in chapters four and six respectively. The third was seen to be unsuccessful as a means for excluding the supernatural from science, representing neither a necessary nor sufficient criterion for considering a discipline scientific, nor being a criterion which supernatural investigation could not accommodate.

In the second category we addressed the ideas of testability, explanation and prediction, methodological naturalism, anti-realism, and tentativeness and integrity. The first and second of these notions will be discussed in much greater detail in chapter five. Methodological naturalism is an issue which we will encounter

throughout this thesis, but for now the arguments presented in favour of it support at best a tentativeness regarding accepting supernatural hypotheses, rather than the complete separation outlined by the NOMA principle. That said, it does raise interesting questions regarding the relationship between metaphysical assumptions and science, which will be returned to in chapter six, although they broadly lie beyond the scope of this investigation.

Anti-realism presents an area of discussion which is of some interest to our debate, particularly given the overlap between entities we often think of as 'supernatural' and 'unobservables'. However, while this is a potential area for future research, it is not relevant enough to our current discussion to warrant further investigation here. Tentativeness and integrity, whilst perhaps qualities which have been lacking from prominent supernaturalists claiming to be scientific, are not qualities universal to scientists, nor qualities absent from the supernaturalist community. While these concepts might be appealed to in order to deny the status of specific supernaturalists as scientists, it does nothing to determine the status of the supernatural as unscientific.

Finally we looked at the relationship between science and social structure. Although it may well be true that supernaturalists have not engaged with the scientific community to the extent that they could fall under a sociological definition of science, and further that scientists have in general rejected the claims of supernaturalists, this does not provide us grounds to defend separationism as a principle rather than a description of the current state of science's relationship to the supernatural. Science was historically considered capable of investigating phenomena we would commonly consider to be supernatural, and there seems little to say that this could not be the case in the future. In order to address the more social aspects of this discussion however we will need to turn to the supernaturalist side of the debate, and eventually the issue of religion.

Chapter 3

Defining the supernatural

In the previous chapter we collated a list of potential conceptions of science in order to evaluate their compatibility with the supernatural. In this chapter we shall approach the discussion from the other direction and address potential conceptions of the supernatural in order to evaluate their compatibility with science. As before we will not focus on whether or not any particular conception is viable, as such an analysis is beyond the scope of this thesis. Rather we will simply outline prominent ways in which we might understand the supernatural in order to see whether or not they provide any reason to adopt a separationist position.

We will first address two distinctions drawn by Steve Clarke between the supernatural and the "merely nonnatural", and between relative and non-relative accounts (2007). These distinctions add a layer of complexity to the discussion which it is important to acknowledge, though they will not hugely interfere with our ability to address the issues at hand. This is briefly followed by an acknowledgement that we might be able to construct a definition of the supernatural as that which is not investigable by science, though such a definition is fruitless here due to the inherent circularity it raises.

Three more promising conceptions of the supernatural will then be discussed which relate back to the discussion regarding the definition of 'science': firstly the idea that the supernatural is that which 'violates' natural law; secondly the notion that the supernatural is somehow not part of the physical realm; and thirdly that the supernatural exists beyond the borders of space and time. As previously stated, the issue of natural law will be afforded its own chapter. The relationship between the supernatural and the physical is not a discussion that I will engage in specifically at great length however. While there is certainly a degree of overlap between those phenomena commonly thought of as the supernatural and the non-physical, they are by no means coextensive categories. Moreover, many of the issues pertaining to the

issue of physicalism are addressed in the discussions on natural law and the supernatural as that which is beyond space and time. This latter topic will be given a fuller discussion, alongside natural theology, in chapter six.

The final section of this chapter shall draw a further distinction that it is important to acknowledge: that between the 'supernatural' and the 'religious'. Although the specific topic of our discussion relates to the former, the sheer degree of overlap between the two in terms of both content and references within the debate means that we cannot avoid simultaneously discussing the latter. I will therefore discuss two potential distinctions between science and religion in terms of the goals and epistemology of each discipline. Generally speaking, while there are differences in the approaches of science and religion, these distinctions do not preclude science from addressing at least some of the questions that fall into the religious domain. This discussion will be returned to in chapter seven.

Finally, we will address an argument from Plantinga (1983), which points to the different ways in which we might arrive at religious belief, independently of any assumption about the methodology of science. While this is an argument which I do not oppose, it does not impact upon science's ability to arrive at its own answers to the questions posed by religion.

What is the supernatural?

The supernatural and the nonnatural

We mentioned earlier that the supernatural, even if understood as being meaningfully distinct from the natural, is still a difficult notion to pin down. In the same way that we discussed with science, perhaps we can identify a common trait that differentiates the supernatural from the natural, and does so in a way that precludes it from scientific investigation. As before, rather than attempt to establish any 'correct' definition of the supernatural, I shall instead collate a series of potential

meanings, and discuss where potential incompatibilities with scientific investigation might arise. Before doing this however, it is worth discussing briefly some further distinctions which go beyond a simple supernatural/natural dichotomy.

Clarke (2007) outlines two important distinctions regarding our conception of the supernatural. The first is between relative and non-relative understandings of the supernatural, and the second between the supernatural and the nonnatural. Relative conceptions of the supernatural depend on the definition of what is natural, such as we saw earlier in the definition outlined by Draper. If our conception of what is natural changes, so too does our conception of the supernatural. Non-relative conceptions adopt a more fixed conception of the supernatural as occupying a separate "realm" to the natural, most apparently observed in the Christian conception of God as existing distinct from the spatiotemporal manifold we inhabit. On this understanding, no matter what we take to be 'natural', the supernatural realm remains clear and distinct, at least in principle.

Clarke's second distinction highlights the idea that supernatural phenomena are supposed to stand in a specific relation to the natural; specifically they are supposed to stand "above" nature in some meaningful sense. He distinguishes between the notion of God as creator, standing above the natural universe and "a possible world that is wholly unconnected to the natural world and is not based on a spatio-temporal system at all" (2007: 282). The former, he suggests, we would consider supernatural, but the latter he terms "merely nonnatural". Clarke argues that these two categories are both subcategories of the nonnatural, and that we should not confuse them: "It seems that we must recognize the possibility of the nonnatural that is inclusive of the supernatural and the nonnatural that is exclusive of the supernatural. The natural and the supernatural are contraries, but they are not contradictories." (2007: 282). This echoes Draper's suggestion that some entity (x) is supernatural if "x is not a part of nature and x can affect nature" (2005: 277). If x is not a part of nature, but x cannot affect nature, then it would be merely nonnatural rather than supernatural.

I do not wish to defend or deny Clarke's summary of the spread of supernatural conceptions beyond noting that I consider it a plausible account. These distinctions are important to note as we shall address both relative and non-relative conceptions of the supernatural throughout the discussion, as well as the nonnatural and the supernatural. Where possible, I will treat the supernatural as being as large a subcategory of the nonnatural as is reasonable. The broader an understanding of the supernatural that falls plausibly within the domain of science, the stronger the case against separationism becomes. As the arguments we are discussing specifically refer to the exclusion of the supernatural however, I shall not expand the discussion to cover the entirety of the nonnatural. With that in mind, let us turn to a relative conception of what it is to be supernatural.

The supernatural as that which cannot be investigated by science

We have encountered the above definition before and, in the context of this thesis, this might seem a strange definition of the supernatural, as it leads to an obvious circularity. If we define the supernatural in terms of what cannot be investigated by science, then separationism offers us no independent justification to exclude phenomena from scientific investigation on the grounds of supernaturalism. However, outside of the context of this discussion, this stands as a legitimately tempting account. We have seen that there are many conceptions of what science is, and that supernatural phenomena are considered to be 'beyond' their scope. On this understanding, supernatural phenomena would simply be whatever lay beyond the scope (in principle) of empirical investigation and scientific method. This would provide a clear-cut distinction between the natural world (the realm of science), and the supernatural world (not the realm of science).

As discussed, this would be a relative account of the supernatural, and some entities previously considered supernatural may become naturalised as we expand our notion of what science can investigate. This is not to say that supernaturalism is temporally or culturally relative, for example in the sense that lightning was once

supernatural in nature, but became naturalised as our capacities to understand it evolved. Rather it is to say that, whatever the theoretical limits to our scientific capacities are, that which lies beyond them is the realm of the supernatural. If Popperian falsifiability did prove to be a proper demarcation between the domain of science and that which is not science, then supernatural phenomena would be those which were not falsifiable in principle, not simply those phenomena which we are not presently able to falsify.

Unfortunately, of course, this cannot be the meaning employed in the discussions given so far. If we understand the supernatural in this way then the proclamations made by the various courts and scientific organisations which have decreed creationism unscientific *because* it is supernatural would be fatally circular. As Maarten Boudry argues: "To give substance to such a territorial demarcation claim, one needs to come up with a coherent and nontrivial definition of natural versus supernatural that does not already *presuppose* the demarcation between science and non-science" (2013: 85, emphasis as original). Therefore, while this stands as a potentially viable definition of what it is to be supernatural outside of the separationism debate, it cannot be used to argue for a separationist position without circularity, and thus is not a definition that is useful to our discussion.

It should be noted here that while this definition is not useful for our discussion, as it offers none of the normative force required for the kind of exclusion we are discussing, it may have use elsewhere. Recall our two-dimensional grid from chapter one, which divided views according to whether or not somebody held a separationist view, and whether or not they accepted a particular supernatural claim. If we understand separationism in a *descriptive* sense, rather than a normative one, there will be people who non-trivially occupy the quadrant which answers both questions in the affirmative. In other words, they will believe that supernatural entities are those things which cannot be investigated by science, and also believe that such entities exist. Though they will not have grounds for what Boudry describes as a "territorial demarcation claim", it is not so simple to dismiss their position.

The supernatural as that which violates the laws of nature

We have already noted that the suggestion that science relies on appeal to natural law has been proposed as a defence of the separationist position. This does, of course, rely on the notion that supernatural phenomena are understood to involve such violations.

There are multiple facets to this particular conception of the supernatural, but from an initial intuitive and etymological perspective it does seem highly plausible. The supernatural being that which is 'super', which is to say 'above' the natural, suggests phenomena that are not bound by the laws governing the natural realm. As theologian Horace Bushnell expressed the term:

That is supernatural, whatever it be, that is either not in the chain of natural cause and effect, or which acts on the chain of cause and effect, in nature, from without the chain. (1958: 37)

With that said, we must also observe that many supernatural phenomena and beings are not considered to consistently violate natural laws. In the popular culture for example, while vampires are often thought to behave in many ways that are inconsistent with natural law, they are still thought to be subject to the effects of gravity. In more philosophical and theological circles, many have taken God to act through natural mechanisms, as is the case with a theistic evolutionary perspective. As Pope Francis, speaking in October 2014, phrased the position:

When we read about Creation in Genesis, we run the risk of imagining God was a magician, with a magic wand able to do everything. But that is not so. He created beings and let them develop according to internal laws which He gave every one, so they would develop, so they would reach maturity. (Davies, 2014)

For the purposes of addressing the separationist charge, we shall discuss the idea that the supernatural involves some violation of natural law in chapter four. Usefully, this particular area of supernaturalism has been given much attention thanks to David Hume's famous discussion 'Of Miracles', in which he employs the definition that "A miracle is a violation of the laws of nature" ([1777] 2004: 73). This

will afford us ample scope to address the separationist argument from the perspective of understanding supernaturalist claims in such terms.

The supernatural as non-physical

One might wish to suggest that supernatural phenomena can be understood as being non-physical phenomena, or as being distinct from the physical universe. This is a compelling idea, it captures classically supernaturalistic entities such as ghosts, spirits, and certain gods, and it also neatly delineates between body and soul. This latter distinction is particularly relevant to our discussion as it is an obvious example of a realm where scientists (biologists and physicians) are granted dominion over the body, and non-scientists (theologians and other religious experts) are granted dominion over the soul.

This is a complex discussion that overlaps with several of the issues to be discussed in this thesis, but it is worth noting some *prima facie* objections to dividing the supernatural from the natural in this way. Firstly, we do not assume that non-physical phenomena are 'supernatural'. Minds and abstract objects, even if taken to be actually existent independent entities, are not usually considered to be supernatural phenomena, falling either into a broader conception of the 'natural' or else into Clarke's "merely nonnatural". Despite this, abstract objects (and possible worlds) lie even further outside the sphere of the natural than that which we consider supernatural, given that abstract objects do not stand in the kind of causal relations with the physical that we discussed earlier in the chapter (Craig, [1984] 2008: 108).

We do not consider all non-physical phenomena supernatural, nor do we assume all supernatural phenomena to be non-physical. Many of the most commonly conceived fantastical supernatural beings seem to be very much physical in nature. Unicorns, goblins, fairies, and even the gods of the ancients all display physical characteristics. Even ghosts appear to be detectable by the senses, and have some

kind of spatial location and extension. We thus find that non-physicality is neither sufficient, nor necessary, to determine an entity's supernaturality, at least as far as our intuitions carry us.

Of course, this is only a superficial treatment of the discussion. One might defend the distinction as valid, but argue that goblins, unicorns, minds and abstract objects are simply 'mislabelled'. Alternatively, one might simply dissolve the distinction between nonnatural and supernatural phenomena, determining that everything which is both existent and nonnatural is in fact supernatural. Finally, one might argue that important additional criteria have been overlooked, and that a more sophisticated account of the distinction can be successfully applied. That said, even if we allow for these possibilities, and discount any possible objections to the distinction, there is a more fundamental problem with this conception of the supernatural with regards to our discussion: namely that science is not limited to the investigation of physical effects.

As we discussed earlier, psychology is an example of a discipline which we could plausibly consider 'scientific' (or at the very least, a discipline that one could practise scientifically). However psychology studies the mind which, if it is an actually existent independent entity, would seem to constitute a non-physical phenomenon. While one might once again wish to argue that we are simply 'mislabelling' psychology here, it is worth noting that even physics was at one time thought capable of investigating non-physical phenomena:

The nineteenth-century discovery of the conservation of energy continued to allow that *sui generis* non-physical forces can interact with the physical world, but required that they be governed by strict force laws. This gave rise to an initial wave of naturalist doctrines around the beginning of the twentieth century. *Sui generis* mental forces were still widely accepted, but an extensive philosophical debate about the significance of the conservation of energy led to a widespread recognition that any such mental forces would need to be law-governed and thus amenable to scientific investigation along with more familiar physical forces. (Papineau, 2007)

Here we see once again the suggestion that a phenomenon need only be amenable to investigable laws in order to be considered scientific, we also see that there was initially no assumption that non-physical phenomena should be considered beyond such laws. Indeed, it seems that unless it were possible to investigate these phenomena scientifically, how could we know that they do not conform to lawlike behaviour? What knowledge of ghosts do (or could) we possess that allows us to determine both that they do not conform to predictable laws, and *also* that they are not within the realm of scientific investigation? If such knowledge is possible, then by what means other than scientific investigation could we arrive upon it?

Again, we will discuss the suggestion that supernatural phenomena violate the laws of nature in the next chapter, so we will leave these questions for now.

The supernatural as that which exists beyond space and time

Clarke's account of a non-relative conception of the supernatural derives from the notion that "we inhabited a mechanistic universe in which Nature was conceived of as being a discrete orderly realm governed by immutable laws [...]. By providing us with a clear sense of the natural, Newton and others paved the way for the widespread usage of a reasonably clear sense of the supernatural, as that which has its recent origin in powers that are not part of the natural realm." (2007: 279-280). Put loosely, if we take our understanding of the natural universe to be that outlined by our scientific conception (a multi-dimensional spacetime manifold potentially originating at the Big Bang), then nonnatural phenomena are those things which exist beyond that universe. These nonnatural phenomena can then be divided into the supernatural and the "merely nonnatural" in terms of which ones have causal efficacy in our universe.

This notion, and its difficulties, is summarised in Bede Rundle's criticism of the coherence of supernatural intervention:

The difficulty with a supernatural agent is that it requires one foot in both domains, so to speak. To qualify as supernatural it must be distanced from any spatio-temporal character which would place it in our world, but to make sense to us as explanatory of changes therein it must be sufficiently concrete to interact with material bodies, and the more convincingly a case is made for the former status, the greater the difficulty put in the way of the latter. (2004: 27-28)

Here we see that for Rundle, for an entity to qualify as supernatural it must in some way exist externally to space and time, and yet also have causal efficacy within it, and these two requirements work in opposition to each other. While Rundle views this as problematic, others have employed the notion in order to argue *in favour* of belief in the supernatural. William Lane Craig, in his defence of the *kalam* cosmological argument, has argued that the universe requires a cause for its existence, and that by necessity, that cause will not be part of the spatio-temporal manifold:

Therefore, an uncaused, personal Creator of the universe exists, who sans the universe is beginningless, changeless, immaterial, timeless, spaceless, and enormously powerful.

This, as Thomas Aquinas was wont to remark, is what everybody means by "God." (Craig and Sinclair, 2009: 194)

A discussion of whether or not supernatural entities might be thought to exist external to, but causally efficacious in, the spatio-temporal manifold will take more space than is available here. This is compounded by the fact that such a conception does, as Craig says, seem heavily implicit in the common conception of "God". We shall thus return to this topic in chapters four and six. This is however a prudent juncture to return to an important distinction mentioned at the end of the previous chapter: that between the 'supernatural' and the 'religious'.

Differentiating the supernatural from the religious

As we saw in chapter one, in the section on pro-supernaturalist, pro-separationist arguments, Lord Jonathan Sacks argued that religion was about "interpretation",

rather than "explanation". Throughout the chapter, we also saw that a primary motivation for this discussion is due to the First Amendment to the American Constitution, which specifically prohibits the establishment of a "religion" by Congress. While this is indeed a key factor in our discussion, it is important to note that the terms 'supernatural' and 'religious' are not synonymous. Ghosts, goblins and unicorns are all supernatural phenomena according to the common understanding, but they are not limited to the domain of religion. Pursuant to this, arguably, not all religious beliefs are supernatural. Gillette (2006) for example has defended the possibility of religious naturalism.

Statements such as those made by Sacks add a further layer of complexity to the discussion. Although we are discussing the exclusion of 'supernatural' phenomena from scientific investigation, a term that can be discussed independently of the various aims and practices of religion, it is undeniable that much of the content of our discussion will regard claims that are religious in nature. Indeed, given that our focus on creationism is so inextricably linked to the God of Christianity, it may not be possible in practical terms to separate our discussion from religion at all. With that in mind then, let us consider Lord Sacks' claim, and those like it, in more detail. We shall approach this in two ways, firstly by addressing a difference in the social (or rather, teleological) aspect of religious discussion, and secondly by considering a potential difference in the epistemology of religious thought.

The goals of science and religion

An important difference between religion and science is that practitioners of religion have different *goals* when it comes to their approach to knowledge. Scientists, at least for the purposes of our discussion, can generally be understood to be primarily concerned with *truth*. Science, in an explanatory capacity, aims to arrive at true propositions about the way the world is. Or, more humbly, science aims to provide explanations for true observations of the world. Although religion is also concerned with this, it is arguably a secondary concern. As Mikael Stenmark argues:

We could say that religion has a *soteriological goal*. In Christianity this typically means that salvation lies in a personal relationship with God through Jesus of Nazareth. Science, on the other hand, is generally understood to lack this kind of concern. (2007: 780)

Pursuant to this, although both science and religion operate communally, they arguably approach the increase of knowledge differently. Where science seeks, as a cooperative enterprise, to increase the *cumulative* knowledge of the society in which it is located, religion aims to increase the *individual* knowledge of each of its practitioners. As Stenmark continues:

A crucial difference between the epistemic goals of the two practices is then that in science the aim is to increase the *general body of knowledge* about the social and natural world, whereas in religion it is to increase the *knowledge of each of its practitioners* to such an extent that they can live a religious life successfully. To contribute to the epistemic goal of religion is first of all to increase, up to a certain level, the religious knowledge (say, at least to the level necessary for salvation) of as many people as possible (although Judaism is one exception to this rule). It is not, as in science, to move the frontiers of knowledge of nature and society forward as much as possible. (2007: 780)

What this implies with regards to discussion is that although there may well be significant overlap in the *topics* discussed in scientific and religious circles, say the origin of the first human, the *approach* to these topics as well as the *questions* that are asked will be significantly different. This returns us to Gould's argument from chapter one regarding non-overlapping magisteria: "[W]e study how the heavens go, and they determine how to go to heaven" (1997: 18).

In our terminology from chapter one, this distinction can be seen in the arguments from the pro-supernaturalist, pro-separationists. As Sacks argues: "There is absolutely nothing in science – not in cosmology or evolutionary biology or neuroscience – to suggest that the universe is bereft of meaning, nor could there be, since the search for meaning has nothing to do with science and everything to do with religion" (2011: 27). For them, achieving a personal relationship with God is not contingent on *how* life arose, but rather *why* life arose. It is not the distinction between natural and supernatural that distinguishes the magisterium of science from the magisterium of religion (both 'how' God created life and 'why' God created

life require supernaturalist answers), but rather the type of question being asked. Thus, even if there is a genuine reason to accept the NOMA principle, this does not imply that science cannot investigate supernatural claims, *even* ones of a religious nature.

Although there is scope to distinguish religious discussion from scientific discussion by acknowledging that certain 'why-questions' might lie beyond the reach of science, it is important to recognise that this does not imply that *all* why-questions lie beyond the reach of science. As van Fraassen observes, a why-question is simply a particular type of request for an explanation. If there is a car crash in which someone is killed, and we ask a physician 'why did that person die?', then we are asking them to explain that person's death. This would also apply if we asked the same question of a mechanic, but they would give a different answer. There is no appeal to a supernatural or teleological explanation implied in either of these questions, and we would not expect one:

The physician explains the fatality *qua* death of a human organism, and the mechanic explains it *qua* automobile crash fatality. To ask that their explanations be scientific is only to demand that they rely on scientific theories and experimentation, not old wives' tales. (Van Fraassen, 1993: 282)

Similarly, for a supposedly 'religious' why-question to be scientific, it needs only to appeal for an explanation framed in scientific terms. Or, at least, it only needs to be *possible* to satisfactorily answer the question in scientific terms. If one asks 'why are we moral?', a sphere of discussion classically reserved for religion and philosophy, then a potential scientific answer might appeal to something along the lines of evolutionary benefits to certain types of social behaviour: "Many of us believe that among our various moral duties, we have special and stringent duties toward family members. Might this 'moral intuition' be attributable, at least in part, to an evolved tendency to favour members of one's kin group over others, analogous to similar traits in other animals?" (FitzPatrick, 2008). The scientist, the philosopher and the theologian may provide different answers, but all three seem perfectly entitled to attempt to answer the question.

Of course, while a 'scientific' interpretation of the question, and a similarly 'scientific' answer may be proposed, this is not to say that either of these approaches will lead to a correct answer. If our morality is indeed derived from a supernatural deity, existing beyond the realm of empirical investigation, and for the purposes of achieving salvation, then a scientific investigation may be ultimately fruitless. That is not, however, to suggest that such an investigation should be pre-emptively discouraged, nor that it should not be considered scientific. Even if we accept the NOMA principle to the extent of allowing for religious and scientific approaches to differ in the same way as those of van Fraassen's physician and mechanic, we see no reason to take this to imply the kind of separationism that would preclude any kind of scientific approach to the question whatsoever.

We see then that although why-questions pose a potentially valid area of exclusivity for religious, rather than scientific, discourse, these questions are not determined by their supernaturalism, but rather by the type of question being asked. Moreover, we should not leap to conclude that *prima facie* religious why-questions, such as those regarding the nature of morality, lie beyond the scope of scientific investigation. We shall return to this subject in our concluding chapter when we discuss religious approaches to the separationism debate. For now however let us turn away from the type of questions being asked by science and religion, and instead to the method of arriving at answers.

Religious beliefs as "properly basic"

We will discuss in chapter six what I shall refer to as 'atheological arguments' from observation of the natural world. In brief terms, these are evidential arguments from which it is argued one can conclude either that there is no such being as God, or else that belief in the existence of God is unjustified or irrational. However, we must be aware that this evidentialist approach is not philosophically conclusive, and there are other epistemological avenues that might be taken. We might acknowledge that scientific methodology can be employed in investigating

supernatural claims, and that scientific conclusions may be drawn from such investigations. However, it would be remiss to assume that such conclusions must therefore be accepted as a requirement of rationality.

As Plantinga ([1983] 2000: 46-49) argues in discussing the evidential problem of evil (see chapter six), we may well accept that the probability that God exists is low with respect to our knowledge of the amounts and varieties of evil in the world, without being obliged to accept that it is therefore unlikely that God exists with respect to the total sum of knowledge available. He compares the situation to that of Feike, a member of the Frisian population, only one tenth of whom can swim. Given this information, he argues, one might conclude that it is unlikely that Feike can swim. However, Feike is also a lifeguard, ninety-nine per cent of whom can swim. With respect just to the information about Feike being Frisian, it is unlikely that Feike can swim. But with respect to the sum of our knowledge about Feike, it is highly likely that he can swim.

Similarly, we might consider a non-scientific basis for belief in God to counterbalance a scientific basis for disbelief in God. One avenue for which Plantinga argues is a rejection of both evidentialism and what he refers to as "classical foundationalism", which he takes to be the position that any rationally held foundational belief will be either "self evident or evident to the senses or incorrigible" ([1983] 2000: 82). Instead, he argues for a version of "reformed epistemology", according to which one can be warranted in holding to a belief that is neither self-evident, evident to the senses or incorrigible, nor follows from a belief that is self-evident, evident to the senses, or incorrigible. Further, he argues that belief in God is an example of such a "properly basic belief"¹².

Plantinga's position is worth noting in regards to two distinct issues. Firstly, the general philosophical issue that science is not, outside of a fairly extreme form of scientism, taken to be an exclusive source of knowledge. Moreover, it is not much

¹² Or, rather, that belief in God follows from other such basic beliefs, such as "God is speaking to me" or "God disapproves of what I have done" ([1983] 2000: 88).

less controversial to hold that science represents the most reliable source of knowledge. It may well be the case that there are beliefs which run contrary to the findings of the scientific community and yet which one may be rationally justified in holding. We shall discuss this issue further in chapter seven.

More specific to the discussion at hand is consideration of something like John Calvin's *sensus divinitatis*:

There is within the human mind, and indeed by natural instinct, an awareness of divinity. This we take to be beyond controversy. To prevent anyone from taking refuge in the pretense of ignorance, God himself has implanted in all men a certain understanding of his divine majesty [...]. Men of sound judgment will always be sure that a sense of divinity which can never be effaced is engraved upon men's minds. Indeed, the perversity of the impious, who though they struggle furiously are unable to extricate themselves from the fear of God, is abundant testimony that this conviction, namely, that there is some God, is naturally inborn in all, and is fixed deep within, as it were in the very marrow. ([1536] 1960: 43, 45-46)

Although Plantinga does allow for the possibility of evidence weighing against properly basic beliefs, that the theist may appeal to a source of warrant which is not only non-evidential, but perhaps not even reliant on the senses as conceived of in a non-theistic picture at all, illustrates a potential deep divide between science and religion. This problem is compounded even further by the complex notion of 'faith' within theistic thought, as we shall discuss further in chapter seven.

The possibility that religious views might be construed as differing from scientific accounts in this way however does not grant sufficient motivation for the separationist position. Even while defending belief in God as properly basic, Plantinga allows for the possibility that sufficient counter-evidence might undermine that belief. He argues that justification conditions for a properly basic belief offer *prima facie*, rather than *ultima facie* justification for belief:

My being appeared to treely gives me a *prima facie* right to take as basic the proposition *I see a tree*. But of course this right can be overridden; I might know, for example, that I suffer from the dreaded dendrological disorder, whose victims are appeared to treely only when there are no trees present. ([1983] 2000: 90)

We can see then that if Plantinga is correct, then even though one might arrive at a religious position through non-scientific methods, this does not render science mute on the subject. To return to the creationist position, one might hold a basic belief of the sort "God has told me that the Earth is 6,000 years old". Clearly however, science is not mute on this topic, and neither the 'basic' epistemological nature of the claim, its religious nature, nor its supernatural nature, render it otherwise.

What we might concede to the creationist however, is that they are perfectly at liberty to maintain their belief in spite of the scientific evidence. Contra the separationist, this does not imply that science has nothing to say on the subject of the creationist position: it absolutely does. However, that science has something to say does not imply that what science says is therefore *definitive*. One may well argue that there are other paths to knowledge, and that science has not won the battle for epistemological supremacy just yet. Regardless of how one feels about the status of science in this regard however, "[e]volution is one of the most robust and widely accepted principles of modern science" (AAAS, 2006). Whether religious (or philosophical, or aesthetic, or moral) views may be derived non-scientifically, or whether there are alternative avenues to finding truth than those followed by science, has no bearing on this whatsoever.

Conclusion

In this chapter we have identified a few distinctions which further complicate our understanding of the separationist position. There are important distinctions to be made between the 'supernatural' and the 'nonnatural', and the 'supernatural' and the 'religious'. While these distinctions do not bear hugely on the overall direction of our investigation, partly due to overlap between the concepts themselves and their relationship to science, and partly due to overlap between the treatment of the concepts in the literature surrounding the debate, it is useful to acknowledge them at least for the sake of philosophical accuracy. They will also be of particular interest

in chapter six when we come to discuss multiverse theory, and in chapter seven when we discuss the limitations to scientific investigation.

It may be possible to construct a definition of the supernatural as "that which cannot be investigated by science". In fact, of the definitions we have covered so far, this seems to be one of the most promising. Unfortunately this definition offers the separationist no normative support, as it renders any prescriptive exclusion of the supernatural from science inherently circular. An alternative definition is, as we have seen many times, that which violates the laws of nature. Whether or not this definition adequately captures either the popular or religious understanding is controversial and, again, shall be addressed in full in the following chapter.

We might also understand the supernatural as in some way not being a part of the natural world. This might be understood in terms of being non-physical, or in the more literal sense of being 'beyond' space and time. Though these conceptions have merit, it fails to capture many of the common examples of supernatural phenomena we encounter. More problematically, while the former offers us little reason to suppose that science cannot investigate the supernatural, I will argue in chapter six that even the latter is questionable in its limiting effect on scientific investigation.

In discussing the distinctions between the supernatural and the religious, we have seen that their domains are not coextensive. We have further seen that while the goals and epistemologies of science and religion are different, they are capable of addressing some of the same topics, including those where supernatural phenomena are involved. They may provide different answers, and these answers may be compatible or contradictory. Moreover, where these answers conflict, one is not obliged to side with the scientist. However, this does nothing to suggest that science must remain mute on topics addressed by religion. The claims of creationism are, as we have seen, religious in nature. As we have also seen, science is not mute on their veracity.

Chapter 4

Science, the supernatural, and violations of a law of nature

In previous chapters we have encountered the idea that the supernatural cannot be the subject of scientific enquiry because they 'violate' laws of nature. As science is seen to deal in such laws, and exclusively so, supernatural hypotheses and phenomena are excluded on principle. To remind ourselves of Ruse's early view on the matter, which has informed much legal and popular opinion since:

Religion does not insist on unbroken law. Indeed, religious beliefs frequently allow or suppose events outside law or else events that violate law (miracles). Jesus feeding the 5,000 with the loaves and fishes was one such event. This is not to say that religion is false, but it does say that religion is not science. (Ruse, 1982a: 73)

In this chapter we shall examine this claim in detail. The subject of what exactly it is to be a law of nature is one of much philosophical dispute, constituting something of a core area of interest in the philosophy of science. As with previous chapters it is not my intent to establish a definitive 'correct' understanding of what it is to be a law of nature, but I am instead interested in whether or not there is reason to think that any of the potential conceptions of such laws conflict with the possibility of scientific investigation of the supernatural. For this reason much of the chapter will be taken up by discussing a range of theories of natural law in turn, and addressing the question of whether or not *any* conception implies an incompatibility with the supernatural. I will occasionally draw attention to various key arguments for and against such theories, but these observations are only intended for the sake of contextualisation and clarity, and should not be interpreted as critical to the overall discussion¹³.

¹³ That the validity of the accounts does not play a role in this discussion is a function of my conclusion that they do not have any bearing on supernatural investigation by science. If it were found that any theory *did* have bearing on this issue, and was sufficiently prominent to justify a separationist position at large, then its validity would of course become highly relevant to the discussion.

In order to discuss the various theories regarding what it is that constitutes a law of nature, I will divide the discussion into what might be termed 'Humean' theories of natural law, and 'non-Humean' theories. The key examples of the former to be discussed – a Naive Regularity view, a functionalist account, and a systems view – will all be deemed incompatible with the notion of a violation of natural law for the common reason that any observation of such a violation would constitute a candidate defeater for any putative law. While one might argue that we can make sense of the notion of a violation on a systems account, this does not imply that science would not be able to investigate such a phenomenon or, at least, integrate it into the body of scientific knowledge.

Regarding the latter category, we shall primarily discuss the notion that laws of nature reflect relations between universals, though some attention will also be given to tendency accounts proposed by Nancy Cartwright and E.J. Lowe. As with systems accounts, it is possible to make sense of the notion of a violation of natural law on such an account, but not in a way which precludes scientific investigation. Finally we shall briefly discuss the issue of anti-realist conceptions of natural law, to conclude that none of these accounts offer weight to the separationist position, even if we assume that they are valid.

After arguing that none of the main theories offer significant reason to exclude the supernatural from scientific investigation I will then move on to discuss some theological and ideological issues that accompany the debate. These issues revolve around philosophical, or at least habitual, commitments to determinism and 'scientism' that can be witnessed on both sides of the theistic/non-theistic divide. Finally we will return to the argument forwarded by Plantinga in chapter one that suggests that no theory of natural law could *even in principle* allow for violation, even granting that supernatural intervention can and does occur.

Although I will only cover a limited number of predominant theories of natural law, it must be noted that while there may exist unknown, or esoteric accounts which *do* exclude supernatural phenomena, this is of little help to the separationist. It is

implausible to suggest that anyone involved in the debate is suggesting that science operates on the assumption that natural laws are best accounted for by hitherto unknown or else highly esoteric accounts, so it is unreasonable to exclude supernatural phenomena on the possibility that they might be. If it is not coherent or reasonable to suggest that supernatural phenomena violate natural laws according to any widely held theory of what those laws are, then the claim that supernatural phenomena should be excluded from scientific investigation on such a basis is unsupportable. At the very least, we should set aside the idea that the supernatural is that which violates laws of nature until we have a conception of what it is to be a law of nature within which this makes sense.

Hume's 'Of Miracles': a historical starting point

In Section X of his *Enquiry Concerning Human Understanding*, entitled 'Of Miracles', Hume lays out a series of arguments that aim to show that we could never be epistemically justified in assenting to the notion that a miracle has occurred. In doing so he provides an early and concrete example of the understanding that supernatural events, here specifically miracles, constitute violations of natural law:

A miracle is a violation of the laws of nature; and as a firm and unalterable experience has established these laws, the proof against a miracle, from the very nature of the fact, is as entire as any argument from experience can possibly be imagined. ([1777] 2004: 73)

Hume clarifies this definition even further:

A miracle may accurately be defined, *a transgression of a law of nature by a particular volition of the Deity, or by the interposition of some invisible agent.* ([1777] 2004: 74, emphasis as original)

It is important to note that Hume is specifically referring to "miracles" here, which does not seem obviously to extend to other supernatural phenomena or entities. On this basic conception it does not seem *prima facie* to be the case that a transgression of a law of nature by a non-deity, or an action on the part of the Deity that did not

transgress a law of nature, would qualify as a miracle, although Hume seems to want to suggest otherwise:

If a person, claiming a divine authority, should command a sick person to be well, a healthful man to fall down dead, the clouds to pour rain, the winds to blow, in short, should order many natural events, which immediately follow upon his command; these might justly be esteemed miracles, because they are really, in this case, contrary to the laws of nature. ([1777] 2004: 74)

Hume's arguments have received much criticism, even on their founding premises. As Lowe observes: "Consider any simple well-established empirical law, such as Hooke's law; how many times must it not have been 'disconfirmed' by a bungling or careless schoolboy? Of course we reject such contrary observations as mistaken, precisely because we believe the law to be true; but what we can't do is insist they never *occur*." (1987: 268). The exact merits of Hume's argument against the possibility of epistemic warrant for believing a miracle story, while interesting, are secondary to the broader question of what it means to say that "a miracle is a violation of the laws of nature". With that in mind, let us discuss what have come to be known as 'Humean' theories of natural law.

Humean theories of natural law

Whether or not Humean theories of law are actually the sort of theories of law that Hume endorsed is a matter of exegetical dispute which I shall not enter into here. We shall instead understand Humean theories of natural law to be those which seem closely related to Hume's account of causation outlined in both his *Enquiry* and in his *A Treatise of Human Nature*:

There appears not, throughout all nature, any one instance of connexion which is conceivable by us. All events seem entirely loose and separate. One event follows another; but we never can observe any tie between them. They seem conjoined, but never connected. And as we can have no idea of any thing which never appeared to our outward sense or inward sentiment, the necessary conclusion seems to be that we have no idea of connexion or power at all, and that these words are absolutely without any meaning, when employed either in philosophical reasonings or common life. ([1777] 2004: 47)

Humean theories of natural law then are those which take laws not to be independently existing "powers" or "connexions" beyond human experience, but instead as *descriptions* of the way we observe the world to be. They are those which understand laws to be observed and exceptionless *regularities* in nature.

Naive Regularity Theory

The most simplistic version of a Humean account of natural law interprets laws of nature to be generalised statements of the form "All Fs are Gs", or alternatively "If F, then G". To take a prominent example, "to every action there is always opposed an equal reaction" (Newton, 1723: 20). Here we would understand Newton's third law as reflecting nothing more than an observed regularity. For every F-type event we encounter (an action), it is accompanied by a G-type event (an equal and opposite reaction). Further examples offered by Hempel and Oppenheim include "All robins' eggs are greenish-blue", "All metals are conductors of electricity", and "At constant pressure, any gas expands with increasing temperature" (1948: 153).

Even critical analyses of regularity theory have considered this an overly simplistic interpretation. A common, and compelling criticism of the account derives from Nelson Goodman's discussion of counterfactuals:

Suppose, for example, that all I had in my right pocket on VE day was a group of silver coins. Now we would not under normal circumstances affirm of a given penny *P*

If *P* had been in my pocket on VE day, *P* would have been silver,

Even though from

P was in my pocket on VE day

we can infer the consequent by means of the general statement

Everything in my pocket on VE day was silver.

On the contrary, we would assert that if *P* had been in my pocket, then this general statement would not be true [...]. Though the supposed connecting principle is indeed general, true, and perhaps even fully confirmed by

observation of all cases, it is incapable of sustaining a counterfactual because it remains a description of accidental fact, not a law. (1947: 122-123)

Goodman's analysis shows that, at least intuitively, we do not want to call something a natural law purely on the basis of it being an exceptionless regularity. Although the problem of supporting counterfactual statements is not entirely alleviated, one minor adjustment to regularity theory to avoid Goodman's objection is to insist that statements of law cannot be restricted to localities. It seems at least far more plausible that "If *P* had been in Nelson Goodman's pocket on VE day, *P* would have been silver" if the suggested, non-localised statement of law were "Every coin is silver."

George Molnar thus attempts to define a law of nature on regularity theory in the following way:

Consider the following definition of a law of nature:

D1: *p* is a statement of a law of nature if and only if:

- (i) *p* is universally quantified; and
- (ii) *p* is omnitemporally and omnispatially true; and
- (iii) *p* is contingent; and
- (iv) *p* contains only nonlocal empirical predicates, apart from logical connectives and quantifiers.

This definition is plainly in the spirit of Hume, though not one offered by him. Whether anybody subscribes to it I do not know, but many modern philosophers accept definitions very similar to this one. I shall refer to it as the Regularity Theory of Laws of Nature. (1969: 78)

David Armstrong, following on from Molnar, calls this theory the "Naive" Regularity theory of natural law:

It is easy to see the aim of the definition: to pick out the *unrestricted* or *cosmic* uniformities from all other uniformities in nature. I will call them *Humean* uniformities, for obvious reasons. These Humean uniformities the Naive Regularity theory identifies with the laws of nature. (1983: 12, emphasis as original)

Even this unrestricted understanding of natural law is not without its problems. Van Fraassen, referencing Reichenbach and Hempel, discusses the following pair of unrestricted observed regularities:

1. All solid spheres of enriched uranium (U235) have a diameter of less than one mile.
2. All solid spheres of gold (Au) have a diameter of less than one mile. (1989: 27)

Van Fraassen grants that, while both of these statements might be true, only the first can be reasonably suggested as a law. The second he argues is a matter of accidental fact. The critical mass of uranium is such that it would prevent a one mile sphere of uranium-235 ever existing. Conversely, while there is not enough gold on Earth, or possibly anywhere in the universe where that much gold is collected, it is not apparently impossible for such a sphere to exist.

Fred Dretske suggests that a further problem with understanding laws in this simplistic manner is that it allows for coextensive terms to be substituted into lawlike statements and produce statements that are *not* lawlike. He gives the example of the predicate expressions "is a diamond" and "is mined in kimberlite". Positing that these terms be taken as eternally and universally coextensive, he suggests that it should be possible to substitute the two terms without changing the nature of a statement. However, "if diamonds have a refractive index of 2.419 (law) and 'is a diamond' is coextensive with 'is mined in kimberlite' [...] we cannot infer that *it is a law* that things mined in kimberlite have a refractive index of 2.419" (1977: 25).

In other words, where F is "is a diamond", K is "is mined in kimberlite" and G is "has a refractive index of 2.419", then if $(x)(Fx \rightarrow Gx)$ and $(x)(Fx \equiv Kx)$, we should be able to infer that $(x)(Kx \rightarrow Gx)$. As we are unable to make this inference (regarding the *lawhood* of the expressions, *not* the truth value, which is unaffected), Dretske argues, there is something wrong with an account of laws that takes them merely as expressions of universal truths. While it might be the case that "If diamonds have a refractive index of 2.419, then rocks mined in kimberlite have a refractive index of

2.419", it is not the case that "If it is a law that diamonds have a refractive index of 2.419, then it is a law that rocks mined in kimberlite have a refractive index of 2.419".

Where then, does this discussion leave us regarding scientific investigation of the supernatural? On a first reading, one might be inclined to think that a Naive Regularity view of natural law prohibits the investigation of the supernatural (or at least, of the miraculous, conceived of as violations of natural law) because a Naive Regularity view entails that the existence of such events is logically incoherent. If there is some natural law, *L*, then any purported violation of *L* simply cannot have occurred by virtue of the fact that *L* is, by definition, exceptionless. As Lowe argues:

The reason why a miracle is logically impossible on the 'Humean' view of laws is that this view represents a statement of natural law as affirming that an *exceptionless regularity* of some sort obtains throughout the universe, without restriction of time or place – so that if *L* is a putative law and *m* a purported miracle 'violating' *L*, one may only judge *either* that *m* *did* occur, thereby constituting a counter-instance to *L* which accordingly cannot be regarded as a true law, *or* that *L* is true and hence that *m* as a purported exception to *L* did *not* occur, *or else* that neither is *L* true nor did *m* occur. What one cannot consistently judge is that both *L* is true and *m* occurred. (1987: 269)

If we understand the Regularity Theory in this way then Overton and Ruse's arguments against the scientific investigation of the supernatural seem to become untenable. Let us take the loaves and fishes example, and posit some potential natural law such that: "It is impossible to feed 5,000 people with only a few loaves of bread and some fish". There are only two possible ways in which the world could be: either the feeding of the 5,000 never occurred at any point in time or space, or the feeding of the 5,000 did occur at some point in time and space. If the first option is true, then the law holds, but has never been violated. If the second option is true, then it is not a law that it is impossible to feed 5,000 people with a few loaves of bread and some fish. Whatever the state of the world, if this interpretation of Regularity Theory is accurate then there can be no violations of laws of nature.

As we see here, and as Lowe has observed, there are two possible options on Naive Regularity theory when we are faced with deciding between some putative law L , and some purported miracle m . We can either deny the possibility of m , or we can take m to represent a potentially disconfirming instance of L . Epistemically speaking, as Hume argued in 'Of Miracles', we might be tempted to favour L in virtue of the fact that it is taken to be affirmed by previously exceptionless experience. However, it makes no sense, and is indeed self-fulfilling, for us to declare that miraculous instances are not within the domain of scientific investigation and then to arrive at the conclusion that it is a law that not- m on the basis of exceptionless observation of not- m . If we do not allow for scientific investigation of m then, quite plainly, we will never scientifically observe m .

This issue is compounded if we remember that a primary motivation, or at least justification, for the separationist position was the NOMA principle: the notion that the domain of science and the domain of religion occupy separate, non-overlapping spheres of thought. However, on a Naive Regularity account, it is not the case that science is mute on the subject of religion. By extending universally, in the ways outlined by Molnar and Armstrong, any scientific law which contradicts some religious claim is an explicit *rejection* of that claim. Moreover, the exclusion of creationism from science on the grounds that it posits violations of natural law is, on a Naive Regularity account, a tacit assertion that creationism is *logically incoherent*. Clearly this is not in the spirit of the NOMA principle that separationists have advocated. Thus separationism is not only untenable on Naive Regularity theory, but *undesirable* as well.

Functionalism

In light of the problems with the Naive Regularity view, particularly regarding the issue of counterfactuals, Goodman argues for a different type of regularity theory. He argues that we can follow the Humean principle that laws should be treated as observed regularities, without appeal to underlying "powers", deeming that

"reference to a notion of causative force can be dismissed at once as unscientific" (1947: 123). He instead posits that we should understand natural laws in terms of their use in prediction:

I want only to emphasize the idea that rather than a sentence being used for prediction because it is a law, it is called a law because it is used for prediction; and that rather than the law being used for prediction because it describes a causal connection, the meaning of the causal connection is to be interpreted in terms of predictively used laws. (1947: 124)

This focus on prediction distinguishes the functionalist account from the Naive Regularity view because it allows for lawlike statements to support counterfactual statements. For example the general principle "Every match that is scratched, well made, dry enough, in enough oxygen, etc., lights" supports the counterfactual statement "If the match had been scratched, it would have lighted" (1947: 122).

Goodman argues further that lawlike statements should not be dependent on particular instances. Thus, while statements such as "All coins in Nelson Goodman's pocket are silver" can be true and also allow us to make a prediction about what we can expect to see if we were to remove coins from Nelson Goodman's pocket one by one, they cannot properly be called 'lawlike' because their acceptance is dependent upon examination of all of the contents of his pocket. Conversely, Goodman tentatively argues, we might be inclined after a few positive instances to accept general statements like "All dimes are silver" or "All butter melts at 150°F" without needing to examine too many further instances in order to confirm them.

Dretske generalises Goodman's analysis to the notion that laws differ from universal truths by virtue of an additional extrinsic feature(s) which determines its role in, for example, scientific prediction: "Laws are to universal truths what shims are to slivers of wood and metal; the latter *become* the former, by being *used* in a certain way [...]. The basic formula is: law = universal truth + X" (1977: 251). He goes on to argue that such an account is unsatisfactory because it implies that lawlike statements *become* laws when we come along and do something with them, but this suggests that prior to our using or confirming their lawlike status, they were not laws. Thus, while it

might be true today that it is a law that "at constant pressure, any gas expands with increasing temperature", it was not true that it was a law a few thousand years ago. Dretske argues that this is unacceptable:

The laws of nature are the same today as they were one thousand years ago (or so we believe); yet, some hypotheses are highly confirmed today that were not highly confirmed one thousand years ago. It is certainly true that we only begin to call something a law when it becomes well established, that we only recognize something as a statement of law when it is confirmed to a certain degree, but that something is a law, that some statement does in fact express a law, does not similarly await our appreciation of this fact. We discover laws, we do not invent them. (1977: 254)

We will discuss Dretske's solution to the problem by appeal to relations between universals later in the chapter, but for now we should turn our attention to how a functionalist account interacts with our understanding of miracles, or the supernatural, as violations of natural law.

There are two separate, and important, issues here. The first, as with the Naive Regularity account, concerns the idea that miraculous or supernatural events constitute violations of natural law. While on the Naive Regularity view this idea seems at least intuitively (if not ultimately) plausible, the same is not true here. The notion that universal truths do not admit of counter instances does not extend to the notion that *predictions* based upon universal truths do not allow for such instances. It is a universal truth, let us accept, that objects fall to Earth at a constant acceleration of approximately 9.81 m/s^2 so long as there is no air resistance. This allows us to predict, via the equations of constant linear acceleration, that a stone dropped in a vacuum from a height of 10 metres will hit the ground after approximately 1.43 seconds. However, if something intercepts the stone, preventing it from hitting the ground at all, then we would not be inclined to suggest that any law has been 'violated'. The purported universal truth upon which we based our prediction is not undermined, but rather our prediction was based upon a lack of complete knowledge of the situation.

It should be clear then that miraculous events, so described by Hume as "a transgression of a law of nature by a particular volition of the Deity, or by the interposition of some invisible agent" ([1777] 2004: 74), do not constitute obvious examples of violations on the functionalist account. It being a law that "human beings do not return from them dead" is not obviously violated by the intervention of a being capable of resurrecting the dead, supernatural or otherwise. The natural law, and our predictive success using it, is based upon the assumption that relevant qualifying factors are ignored. Whether these considerations undermine a functionalist account is open to debate, but that these factors might do so is tangential to the supernaturality of the intervening entity. The law of gravitation is no more or less violated if in our previous example it is a human being catching the stone, or a poltergeist.

The second, and more important issue that arises for the functionalist account is that by virtue of being *inherently* unpredictable, supernatural hypotheses and phenomena fall outside of the realm of possible natural laws and, as such, are excluded from scientific discussion. We have seen this sentiment earlier from Schaferman (1997) when he argued that because "miracles would allow unique, non-repeating, and non-controllable events to cause natural effects" that therefore they would be impossible to make sense of using empirical methods.

But this account seems entirely implausible both from a perspective of 'normal' science and from a perspective of what we consider to be supernatural phenomena. The extinction of the dinosaurs via meteor collision reflects a "unique, non-repeating, and non-controllable" event, but we would be pressed to find any philosopher or scientist who considers it to be outside of the realm of scientific enquiry. Perhaps Schaferman instead intends to suggest that, unlike meteor impacts, supernatural phenomena cannot be discussed in terms of universal truths which can then be applied to specific instances. We do not have knowledge of the underlying universal truths available to us in order to make the kind of predictions (or, in the case of the dinosaurs, explanations) we do in the realm of the purely natural.

That we do not have such knowledge may well be the case, but I would argue that this is a matter of *accident* rather than necessity, at least so far as we do not assume that supernatural phenomena are logically impossible. There is nothing inherently unpredictable about many of the concepts that we consider to be 'supernatural'. Indeed, astrology, tarot reading, and even Biblical prophecy operate almost entirely on their ability to support predictions. That we do not have empirical support for the universal truth of astrological statements, nor can we make reliable predictions based upon them, is a scientific argument *against* astrology, not an indication that there is something inherently unpredictable about supernatural phenomena. It certainly is not a reason to declare that scientific methods cannot be applied to putatively supernatural phenomena.

There are, I would concede, some supernatural phenomena that do not admit of the kind of predictability required by the functionalist account outlined here. As we touched upon in our opening chapter, and shall return to in chapter seven, there may be other factors that prohibit scientific investigation of the supernatural. Some interpretations of certain Biblical verses such as "Do not put the LORD your God to the test, as you tested him at Massah" (The Bible, Deuteronomy 6:16) suggest that applying the kind of predictive methods of science to appeals to God (such as by praying for rain and seeing what happens) go against the teachings of scripture. However, as we shall discuss later, these factors are *additional* to the supposed supernaturality of the hypothesis or phenomenon in question. The relevant question regarding whether or not we can base predictive success upon some known universal truth is not "Is this supernatural?" but rather "Are there any factors or variables here that would impede predictive success?"

A systems approach

The final Humean approach that we shall consider relates laws to deductive systems. These deductive systems are based upon axioms which can logically lead to more generalised theorems. Frank Ramsey and later David Lewis proposed that laws of

nature represent the axioms or theorems that exist in the true deductive systems that best balance simplicity and strength:

We can restate Ramsey's 1928 theory of lawhood as follows: a contingent generalization is a *law of nature* if and only if it appears as a theorem (or axiom) in each of the true deductive systems that achieves a best combination of simplicity and strength. A generalization is a law at a world *i*, likewise, if and only if it appears as a theorem in each of the best deductive systems true at *i*. (Lewis, 1973: 73)

It is trivially easy to maximise either strength or simplicity. One can maximise strength by simply including all true propositions as axioms, or can maximise simplicity by including only one true axiom, say that $2 + 2 = 4$ (Carroll, 2010). The aim of Lewis' account is to find those systems which find the right balance between them. Barry Loewer has suggested that, for example, quantum theory might be part of a such a system. Returning to a slightly modified version of the gold/uranium spheres example:

(U) There are no solid one ton spheres of uranium.
(G) There are no solid one ton spheres of gold.

Loewer argues that:

It is plausible that quantum theory together with propositions describing the nature of uranium entail (U) but not (G). So if quantum theory is part of the best theory of our world, then (U) will be a law. In fact, the reason we think that (G) is not a law is that we think that the best theory of our world is compatible with (G)'s being false. Adding (G) to fundamental physical theory would produce a stronger system but at a great cost in simplicity. (1996: 111-112)

This arguably solves the earlier problem of the Naive Regularity view in that it is possible, under the systems view, that it can be universally true that *P* and still not be a law that *P*. To return to the loaves and the fishes example offered by Ruse, it would not do for us to include an axiom such as "A few loaves and fishes are never enough to feed 5,000 people" in a best deductive system because such an axiom sacrifices a great deal of simplicity. Thus even if we think that it is universally true

that a few loaves and fishes have never, and will never, be enough to feed a few thousand people, we are not obliged to consider this a law of nature.

That said, the picture is not quite so simple. While we might readily accept that "A few loaves and fishes are never enough to feed 5,000 people" is an acceptable sacrifice in formulating a system, there are further implications to such an event occurring. Let us, for sake of argument, assume that the feeding of the 5,000 would represent a violation of the law of conservation of energy. Given this, we would not only have to reject the specific law prohibiting the feeding of the 5,000, but also the more general law regarding energy conservation. This is not quite so comfortable a proposition.

There are a few responses that we can make here. The initial response is simply to accept that, similar to earlier Humean approaches, any axiomatisation which admits of such a counter-instance will not feature in the best system. Therefore, if there has ever been an instance in which a few loaves and fishes have been enough to feed 5,000 people, then the law of conservation of energy does not feature in the best system which maximises both simplicity and strength. Thus there is no sense in speaking of the feeding of the 5,000 as a violation of this law.

The second response is similar in approach to what Lakatos termed "monster-barring" (1976: 15), whereby a generalisation is amended in order to accommodate counter example. We can simply restate Plantinga's argument that the laws of nature are only thought to hold in a closed system. This is perhaps nowhere as clear as it is in the case of conservation of energy and thus, given that God's intervention represents a force which originates externally to the system, no violation actually occurs. We shall return to this kind of response later in this chapter, but for now it allows us to hold that the best systems may well admit of counter-instance to otherwise universal laws. We may axiomatise the law of conservation of energy such that it describes the operation of the natural world as a closed system, rather than an open one.

Finally, we might maintain the law of conservation of energy, but acknowledge that the system doesn't account for the loaves and fishes event. To again borrow from Lakatos, the discovery of an inconsistency does not necessarily mean that we must put an end to a scientific research programme, but rather that "it may be rational to put the inconsistency into some temporary, *ad hoc* quarantine, and carry on with the positive heuristic of the programme" (1978: 58) . While this might be an unsatisfying resolution, it does once more allow us to avoid denying that the loaves and fishes event occurred, whilst also maintaining the law of conservation of energy.

However, we might wish to argue that such responses are unsatisfactory. We might say that omitting the law of conservation of energy on the basis of a single counter-instance involves too great a sacrifice in strength to a system. Similarly we might argue that Plantinga's response sacrifices too much simplicity, and that the nature of the loaves and fishes event makes it impossible to overlook. Instead, we might insist that the law of conservation of energy does in fact feature in the best system, but that the feeding of the 5,000 represents a legitimate counterexample to it. If this were the case, then perhaps we might speak coherently of a 'violation' having occurred. Richard Swinburne has argued along similar lines to these. He asks:

But what are we to say if we have good reason to believe that an event E has occurred contrary to predictions of a formula L which otherwise we have good reason to believe to be a law of nature, and we have good reason to believe that events similar to E would not occur in circumstances as similar as we like in any respect to those of the occurrence of E? (2000: 425)

Swinburne argues that in such circumstances we have three options. We can abandon L entirely, without replacement, which on the Ramsey-Lewis account would result in a massive loss in strength to the system. We can attempt to replace L with some new law which accommodates E, which given the unrepeatability of E in similar circumstances Swinburne argues would lead us to make false predictions. Or, we can accept that L is a law of nature, and that E represents a legitimate counter-instance to it (2000: 425).

Does this then allow us to maintain a coherent separationist position? I would argue not. Swinburne's argument allows us to maintain that a law of nature has been violated given three criteria obtain:

- 1) We have good reason to believe that L is a law of nature or, at least, holds most of the time.
- 2) We have good reason to believe that E has occurred.
- 3) We have good reason to believe that an event like E would not occur in circumstances similar to E.

How then are we to establish the truth of (2) or (3) without scientifically investigating them? We might, of course, appeal to theological reasons, as we presumably would in the case of the feeding of the 5,000. In that instance, we might reasonably say that the theists have good (theological) reason to think that E occurred and also good (theological) reason to think that an event like E would not occur in similar circumstances.

However, while we might grant this to be the case for the feeding of the 5,000, this does not seem to be generalisable to all supernatural, or even theological claims. To return to the subject of Intelligent Design, the arguments forwarded in favour of believing that life was designed are not theological but empirical. We might disagree with the notion that these arguments do in fact qualify as 'good reason' to believe that life was designed, but they do not seem obviously unscientific in principle. Thus even if the claims of Intelligent Design reflect coherent violations of natural law, they do not seem obviously outside of the domain of science solely on that basis.

More problematically for separationism, we can plausibly argue that there are examples of events which would constitute violations of laws of nature, but that we can scientifically investigate to determine that they did not occur. Take, for example, the claim that God created the world six to ten thousand years ago *ex nihilo*. Let us assume that this violates the law of conservation of energy, and also that in similar circumstances that this event, E, would not reoccur in similar circumstances. We

would, therefore, be justified in accepting that this constitutes a genuine example of a violation of a law of nature if we can establish (2): that we have good reason to believe that E occurred. However, while we might concede that there is theological reason to think that E did occur, we could surely not also concede that science has nothing to say on this issue.

We thus return to the arguments from Plantinga and Laudan we saw in chapter one. The separationist position denies both the advocate and the detractor of the supernatural the ability to investigate their claims, and this is the case even for weak separationism. While we might maintain that some theologically (or otherwise non-scientifically) motivated beliefs concern events or facts which constitute legitimately uninvestigable violations of natural law, this covers only a fraction of the total set of supernaturalistic claims.

It seems then that none of the major Humean accounts justify an acceptance of the separationist position. Any account that is based on observation of exceptionless regularities cannot coherently accommodate a violation. If we derive our laws from observation of the world, and some fact in the world contradicts that law, then it will always be our lawmaking attempts that have proved inadequate to describe reality, rather than some failure on reality's part to fit with our previous observations. Even if we do manage to make sense of a violation on a Humean account, it gives us little reason to accept the separationist position. Let us therefore turn our attention to non-Humean accounts.

Non-Humean theories

Relations between universals

The first non-Humean theory we shall address attempts to distinguish between the notion that laws just *are* universal truths, and the notion that laws can *imply*

universal truths by virtue of an actual relation not between *F*s and *G*s, but rather *F*-ness and *G*-ness. As Armstrong outlines the theory:

Suppose it to be a law that *F*s are *G*s. *F*-ness and *G*-ness are taken to be universals. A certain relation, a relation of non-logical or contingent necessitation, holds between *F*-ness and *G*-ness. This state of affairs may be symbolized as '*N(F,G)*'. (1983: 85)

Dretske argues that this approach solves the earlier difficulty in moving from "diamonds have a refractive index of 2.419 (law)" to "things mined in kimberlite have a refractive index of 2.419". He argues that even if "is a diamond" and "is mined in kimberlite" are coextensive, there is no reason to think that relations between those properties and other properties should be maintained:

If "*F*" and "*K*" are coextensive, we cannot substitute the one for the other in the law "All *F*'s are *G*" and expect to preserve truth; for the law asserts a connection between *F*-ness and *G*-ness and there is no guarantee that a similar connection exists between the properties *K*-ness and *G*-ness just because all *F*'s are *K* and vice versa. (1977: 253)

Moreover, this account appears to offer at least *prima facie* solutions to the problems of prediction and supporting of counterfactuals seen in a Humean account. If we know, or believe, that some relation holds between *F*-ness and *G*-ness, then we can predict, based on an observation of an *F* (a particular phenomenon or entity exemplifying the universal property of *F*-ness) that we can also expect to see a *G*. Moreover, we can reasonably suppose that we can make antecedent counterfactual claims ("if this were an *F*...") and then infer based on the law relating "*F*-ness" and "*G*-ness" that some consequent ("it would be *G*") (Dretske, 1977: 266).

Van Fraassen has objected to the universals approach as outlined by Armstrong by asking us to identify what exactly the relation between *F*-ness and *G*-ness is, and also to show how we can infer that particulars *F* are accompanied by *G* based upon the fact that there is such a relation between *F*-ness and *G*-ness. He argues that, although we *might* concede to Armstrong that the relation between universals simply *is* the causal relationship as we experience it, only now understood to relate types rather than tokens, we cannot extend this concession to the problem of

inference: "If a relation holds between two types, and is the sort of relation that can also hold between their tokens, it still does not follow that their tokens are indeed so related. Romeo and Juliet's fathers hated each other but their children did not." (1993: 436).

Unlike the Humean account, the fact that the universals account describes an actual relation between types, rather than simply observed regularity, makes it a more complicated matter whether or not laws understood in this way admit of violation. Although it cannot be true both that "all *F*s are *G*s" and "some *F* is not a *G*", it *can* be true that "there is a relationship between "*F*-ness and *G*-ness" and also "some *F* is not a *G*". This can be understood simplistically if we consider the relationship between heavy objects and falling. We might accept that there is a relationship between some entity *F* having the property of being heavy, and with the subsequent event *G* involving its descent. However, as can be observed with many objects having the property of heaviness (such as birds), there is no necessary connection between the token *F* (the bird) and a token event (it falling). We shall discuss a conception of natural law which address this issue later in the chapter.

We might, of course, want to argue that laws of nature are not to be understood so simplistically. No one would suggest that it is in fact a law of nature that all heavy objects fall to the ground, or that the property of heaviness *necessitates* falling. We would instead want to suggest that the relationship between heaviness and falling is to be considered in light of other factors, even though the relationship itself is maintained. However, given such a concession, what reason could we then have to think that a miraculous event was a *violation* of such a relation, rather than simply an instance where say, the volition of a deity is one of the factors that must be considered?

Conversely, we might be tempted to argue that it is not tokens failing to behave as would be expected due to the relationship between their types that reflect violations of laws of nature. Rather we might wish to say that the lawlike relationships between properties cannot obtain if one of the properties of a particular token is

supernatural (let us call this property *S*-ness). This could be understood in two alternative ways:

- 1) If the property of *S*-ness is present in any particular token then no property which can exist in lawlike relations can also be present. If *X* has the property of *S*-ness and it is a law that *F*-ness causes *G*-ness, then it is not the case that *X* has the property of *F*-ness.
- 2) If the property of *S*-ness is present in any particular token then no lawlike relation involving its other properties can hold. If it is a law that *F*-ness causes *G*-ness, and *X* has the property of *F*-ness and also the property of *S*-ness, then it is not the case that "If *X* then *G*".

The first possibility here, though potentially functional, seems to contradict our understanding of what supernatural phenomena actually are. Jesus, considered by many to be a supernatural being capable of many supernatural acts, shared many of the properties of non-supernatural entities, even whilst performing those acts. It seems reasonable that we can suppose at least some lawlike relations hold between the type "is visible" and at least one other type. However, even while walking on water, Jesus is quite obviously considered to have remained visible (though it is, of course, another question as to whether he remained heavy).

The second possibility seems more plausible. Moreover, If this account were correct then even if *F*-ness necessitated *G*-ness in a lawlike way, then the property of being supernatural would make it possible for this law not to obtain. In other words, supernatural properties would allow for violations of natural laws. We see here then a potential avenue for a defence of a separationist position. Following on from our suggestion that "is visible" is a property which can stand in lawlike relations, then "is reflected in a mirror" seems a plausible candidate for a relevant related type. However, this relationship would not obtain when the first property type is instantiated by a supernatural entity such as a vampire. This account finds some support in the fact that, were we to ask the question "Why don't vampires have a

reflection?", then we would not be surprised to hear the response "Because they are supernatural."

The problem with this analysis however is that it does not seem to be any more problematic than the idea that "heavy things always fall" is not found to obtain in tokens which also possess a mechanism for flight. If birds do not represent a violation of this relation, then why should vampires constitute a violation of "visible things cast a reflection"? To single out the property of supernaturality as any more problematic than the property of having wings seems here to be arbitrary. Moreover, our understanding of supernatural entities indicates that there are relationships between properties which are *only* exemplified in entities with the property of supernaturality. For example, the relationship between "is a vampire" and "is harmed by contact with a crucifix". If vampires were actually taken to exist then certainly our understanding of natural laws would need to become more sophisticated in order to accommodate these relations, but this does not seem to pose any unique challenges. Indeed, thanks to fantasy and horror literature, we already do have a reasonable understanding of how such relations behave¹⁴.

Alternatively, rather than suggest that the presence of the property of supernaturality in a particular token interferes with other properties of the particular token, we might simply say that a phenomenon is supernatural *iff* the relations between universals are not consistently upheld in relation to it. There is, say, a natural law relating "visible-ness" and "reflected-in-a-mirror-ness", and any visible entity for which this relation does not obtain is to be thought of as 'supernatural'.

If this were the case, however, then it seems impossible that we could ever come to distinguish between a natural law failing to obtain in a supernatural entity and a defeater for a natural law hypothesis. Even if Armstrong's account were correct, *and* this analysis of supernatural phenomena were also correct, then we still would not

¹⁴ As I shall argue more explicitly in chapter seven, I do not consider the term 'supernatural' to have a useful function in this kind of discussion. For now though it does not affect my argument to consider vampires as behaving according to a comprehensible set of supernatural laws rather a comprehensible set of non-actual natural laws.

be justified in adopting a separationist position. Ontologically speaking, the separationists would be correct, but epistemically speaking their claims would be redundant. If we cannot differentiate between instances where a natural law does not hold, and instances where a natural law does hold but its violation is an indicator of supernaturality, then how can the separationist position be applied? We shall discuss this further in the following section.

The most troubling part of all of these discussions regarding supernatural phenomena and natural laws as relations between universals however is the simple question of how we could possibly establish that such relations did or did not hold in any particular 'supernatural' phenomenon *without* being able to investigate it scientifically. If supernatural phenomena do exist then on what grounds can we claim to know how the relations between their types behave *a priori*? We might know that "in the absence of S-ness then a few loaves of bread and some fish will not feed 5,000 people", but this is just as true as it is to say "in the absence of having wings, then a bird will fall to the floor". Similarly, if it were not for our scientific investigations of aerodynamic properties, and perhaps even wings themselves, then we would not be able to make claims about what kind of relations hold in their presence. Without such investigation, then how are we to speak of what kind of lawlike relations do or do not hold in the presence of S-ness? Indeed, how would we be able to identify the presence of such a property at all? Thus, even if relations between the properties of supernatural phenomena are not lawlike, then we have no way to know this prior to scientific investigation of those phenomena and thus no reason to exclude them from such investigation.

Moreover, while one might accept the above reasoning regarding observed phenomena, one cannot even defend the idea that one should avoid supernatural *hypotheses*. If one were to argue that such hypotheses should not be entertained because, along the same lines as Hume, there is overwhelming support for their non-occurrence, then this becomes viciously circular. Supernatural hypotheses would be rejected on the grounds that such events are not seen to occur, thus they would never be subjected to investigation, thus they would not be seen to occur.

Tendencies accounts

An alternative group of non-Humean approaches to natural law suggest that natural laws do not apply universally, but rather describe the way that members of certain sets tend to behave. Nancy Cartwright has argued that, rather than extending universally and eternally, the laws of nature describe a "patchwork" of behaviour patterns: "we live in a dappled world rich in different things, with different natures, behaving in different ways. The laws that describe this world are a patchwork, not a pyramid" (1999: 1).

Cartwright argues that things in nature possess "capacities" to behave in certain ways, but that these capacities are not lawlike regularities, and can manifest very differently in different circumstances. She argues for example that redness carries the capacity to look a certain way under certain conditions, but then in a completely different way in others (1998: 25). The lawlike regularities described by scientists may hold in the extremely restricted environment of the laboratory, but this does not reflect the actual world in which we live:

We may think the natural behavior is for opposite charges to move towards each other and for similar charges, to separate from each other. But it is important to keep in mind that this is not an effect in abstract. That motion, like any other, depends on how the environment is structured. (1998: 25)

An alternative, though related account is described by Lowe. He outlines what he calls the "normative" conception of natural law:

According to the normative account of laws, a statement of natural law (a 'nomological' statement) characteristically implies that *normal* or *typical* individuals or exemplars of some recognizable natural kind possess a certain dispositional property, that is, are disposed to behave or appear in a certain way (usually in certain specifiable conditions). (1987: 273)

These accounts contrast with the Humean conceptions in that they do not insist upon *exceptionless* regularities. Lowe suggests that if, for example, we take it to be a natural law that "ravens are black" then this will remain true even when we encounter albino ravens so long as such creatures are "legitimately characterizable

as *abnormal* members of the species" (1987: 274). He then contrasts this with the similar putative law that "swans are white", observing that this law is *disconfirmed* by the discovery of the Australian black swan.

Although he argues for the normative theory on independent grounds, Lowe claims that the theory also does "justice to the intuition that miracles – conceived as violations of natural law – are at least logically possible" (1987: 273). He argues that on the "normative" conception one could have both a true natural law and an exception to it that was deemed miraculous. Using the example of a levitating table he suggests that:

[I]f the levitation phenomenon turned out not to be repeatable, or only to occur at the command of one particular person and even then not reliably, or if no physical message between the person and table appeared to be involved [...] in addition, the abnormal phenomenon proved recalcitrant to *any* kind of naturalistic explanation (unlike albinism in ravens), it seems we would be faced with a *prima facie* case of a *genuine miracle*. (1987: 277)

Of course on the normative account we do not understand miracles to be 'violations' of natural law in the sense thought by the Humeans. A miracle no more violates the law of nature in question than does an albino raven. The difference being, as Lowe observed, that in the case of albino ravens we are able to identify a naturalistic explanation for their plumage. Instead, miracles constitute violations in the sense of being "naturalistically inexplicable violations or suspensions of the natural order of things [...] without being destructive of that order" (1987: 277-278).

Tendency accounts, if tenable, clearly allow for miraculous events to occur in a sense. Moreover, Lowe's analysis offers us something of a solution to the problem posed in the previous section of distinguishing between an actual natural law failing to obtain, and a defeater to a purported natural law.

However while Lowe's solution may offer us some epistemic grounds for identifying 'miracles' in non-Humean theories of natural law, it remains implausible to suggest that such events would not be investigable by science. This is certainly true in the

sense of investigating the events themselves. A key feature of Lowe's description of the levitating table was that the event was investigable to the point that all naturalistic explanations were ruled out – *including* alternative potential natural laws. This not only allows us to unknowingly investigate supernatural phenomena should some such event occur, but also at least tentatively allows us by *process of elimination* to posit a supernatural explanation as a result of scientific investigation. This methodology allows for at least a superficial scientific investigation of supernatural phenomena even if, though I do not think it is necessarily implied by the account, a deeper investigation proves intractable.

That said, what reason is there to think that deeper investigation would prove intractable? Supposing Lowe's levitating table actually existed, or beings who were visible but cast no reflection existed, then what is there to prevent us analysing the relations that obtain in these instances? Certainly they would be rare occurrences, or else we would not have posited a natural law regarding their non-occurrence. In Lowe's terms, they would not be in accord with "the natural order of things". But simple rareness is not sufficient to warrant exclusion from scientific investigation. Especially in a situation, as described by Lowe, where the event occurred for sufficiently long enough, and in a way amenable enough to investigation such that all natural explanations could be eliminated.

Indeed, we do not need to venture into the realm of the hypothetical in order to see this kind of approach to the miraculous being employed. The Roman Catholic Church employs exactly this kind of process of elimination when assessing intercessory miracles in order to determine whether or not an individual should be beatified or canonised. Most notably, a key feature of their approach involves determining "whether any alleged medical miracle (most all claimed miracles are of this sort) is inexplicable by current medical science" (Harvey, 2007: 1255). For example, this was reportedly the case in 2014, when Pope Jean Paul II was granted sainthood on the basis of 'miraculously' healing the brain aneurism of Floribeth Mora Diaz:

Even her neurosurgeon seems to be convinced. "If I cannot explain it from a medical standpoint, something non-medical happened," said Alejandro Vargas Roman. "I can believe it was a miracle."

She recounted the story on a website linked to the beatification of John Paul II.

It was not long before the Vatican contacted her in what was the start of a long process in which the purported miracle was scrutinised by the experts of the Holy See, led by the Vatican "postulator" in charge of advancing John Paul II's sainthood.

Mrs Mora was flown to a Church-run hospital in Rome, where she was registered under a false name while doctors conducted tests which showed that she was completely healthy. (The Telegraph, 2014)

Although I do not wish to go so far as to declare the church's approach "scientific", it is at least worth noting that it bears significant resemblance to what we might understand the term to mean in a colloquial sense. Miracle investigations involve the collection of x-rays, laboratory reports, and written testimonies, and are assessed by physicians who have been appointed as advisors on the church's 'Medical Commission'. "The physicians of the Medical Commission work only from written records. They work in isolation and do not discuss their work with anyone, even each other, until panel meetings" (Harvey, 2007: 1257).

There are reasons to question the legitimacy of calling this activity, rigorous as it might be, 'science'. If we recall our discussion in chapter two regarding the social structure of science, we saw that one reason that we might not deem creationism scientific was because its practitioners operated independently from science, rather than as a proper 'subcommunity'. Although it would perhaps be unfair to draw too heavy a parallel here, it is certainly plausible that a similar argument might be made in this case also. However, as with our previous discussion, this is tangential to the issue of supernaturalism. If we can indeed identify a coherent understanding of a miracle in something like the senses outlined by Cartwright and Lowe, then the methods relating to beatification and canonisation represent a concrete example of at least a proto-scientific (as opposed to pseudoscientific) approach to the matter.

Thus, even if we grant that on certain non-Humean accounts that violations of natural law might occur, and be identified as such, we still find ourselves no closer to a justification of the separationist position. Either such events cannot be investigated to the extent that they could be identified as violations of natural law, or they can be investigated to such a degree, but by doing so render the separationist position manifestly false.

Anti-realism

Some philosophers, motivated in part by considerations such as those above, have rejected both Humean *and* non-Humean accounts of natural laws. As van Fraassen writes:

We have now seen that any philosophical account of laws needs a good deal in the way of metaphysics to do justice to the concept at all. We have also seen that, as a result, any such account founders on the two fundamental problems of identification and of inference. The extant accounts come to grief additionally in their attempts even to meet the most basic criteria relating to science and explanation. Their promises have all proved empty. (1989: 130)

Thus these philosophers are motivated to *reject* the notion that laws of nature reflect factual states at all. This can be interpreted either in the broad sense that for any supposed law, x , where L is the property of being a law, then $\forall x \neg L(x)$, or else in the narrower sense that "if it is a law that x , then it is not a fact that it is a law that x ".

On the broader understanding we can, without too much concern, conclude that if we define a miracle as a violation of a law of nature, then miracles simply cannot occur. This is not to say that no event which we would habitually refer to as a 'miracle' could not occur (say, the feeding of the 5,000), but rather that if such an event did occur, it would not be a miracle. There can be no event that can be reasonably described as having violated a law of nature if there is no such thing as a law of nature.

However, the latter account is not quite so clear. If we consider one such account, as outlined by Barry Ward (2002), we can see that we might simultaneously reject the notion that the laws of nature express facts, whilst also maintaining a coherent picture of miracles as 'violations' of those laws.

Ward argues that motivations for accepting the Humean picture, despite its numerous and well-documented difficulties, roughly correspond to Lewis' remarks that: "The point of defending Humean Supervenience is not to support reactionary physics, but rather to resist philosophical arguments that there are more things in heaven and earth than physics has dreamt of" (1994: 474). In other words, the Humean is motivated by the desire to avoid the ontological baggage of positing additional nomic states of affairs (such as relations between universals) *on top of* physical facts. He then argues further that, due to the intuitive possibility that there could be multiple possible worlds with identical physical states but distinct sets of laws, that Humean Supervenience is (intuitively) false (2002: 194-195).

Ward instead presents a *projectivist* account of what we mean when we speak of natural laws. Specifically, he proposes an account whereby "law claims are understood as normative claims which express attitudes taken to rules for making predictions and explanations" (2002: 192). Our discourse about natural laws existing *in* the world is in fact a projection of our attitudes regarding certain states of affairs *onto* the world. He argues that lawlike statements such as Newton's Second Law, or that "all sodium salts burn yellow", should instead be understood as what he calls a "Model Generating Rule" (MGR). These MGRs, when initial or boundary conditions of a system are specified, generate predictions regarding that system. In the case of Newton's Second Law, if we know the initial position and velocity of some object in a system, as well as its mass and the forces acting in that system, then we can produce a model that predicts what will happen to the object. He concludes that:

To say of an MGR that it is a law is to express the following attitude: this MGR is one that ought to be used for predicting and explaining. In saying 'it is a law that P' we are singling P out as one of the rules to use for those purposes. It is important to note that it is not implicit in the commitment thus expressed that

there is some fact of the matter determining P as a rule that ought to be used.
(2002: 197-198)

It seems then that we could modify Hume's notion of a miracle as a "violation of a law of nature" as instead being an occurrence which does not conform to the predictive models generated by an MGR given specified initial and boundary conditions. Thus if we agree that we ought to use Newton's Second Law as an MGR for predicting the motion of an object in a given system, and we know the initial conditions of that system, then any result that did not conform to our predictions regarding that object, so long as we have not made an error in calculation or initial measurement, could reasonably be considered a 'miracle' in the Humean sense, and more so if we add the additional qualifier that the failure to predict is the result of "particular volition of the Deity, or by the interposition of some invisible agent" ([1777] 2004: 74).

If this reasoning is correct, then it would appear that an anti-realist account could accommodate the notion of a miracle so long as we adjust our definition of 'miracle' in order to fit the revised schema. However, even if we accept that such an event could be considered a miracle, then we return to the same problems that faced the standard Humean accounts. If we ought to use some MGRs for prediction and explanation, because it is the case that we have always observed that this MGR produces reliable predictive results then any failed prediction will either give us reason to question that the actual miracle occurred or else give us reason to doubt the predictive capabilities of the MGR. Mirroring Lowe's discussion of the Naive Regularity account, it cannot be the case that (i) some MGR *M* has always been observed to produce successful predictions; and (ii) there exists some 'miraculous' event *m* which contradicts those predictions.

Although Ward's suggestion is only one example of an anti-realist attempt to accommodate our intuitive and semantic dispositions towards laws of nature, I think we can reasonably take the above analysis as reason to be at least tentative regarding the status of miracles on a more general level. We cannot simply dismiss

the idea that a violation of a law of nature has occurred on an anti-realist account unless we insist on adhering to the strictest of conceptions of what that means. However, even granting that an anti-realist understanding of laws of nature could *in principle* allow for coherent discussion of miraculous events, then that account can still be scrutinised in much the same way that realist accounts can. This is not, of course, to suggest that no such account could allow for miraculous violation, but it certainly gives us reason to be hesitant before accepting the viability of the separationist approach.

Theistic objections to violations of laws of nature

It should be noted that opposition to the possibility of miracles has also been proposed on theological grounds. As Wesley Wildman summarised the feelings of those involved in the Divine Action Project, a series of conferences and publications co-sponsored by the Vatican Observatory and the Centre for Theology and the Natural Sciences in Berkeley:

The idea of God sustaining nature and its law-like regularities with one hand while miraculously intervening, abrogating or ignoring those regularities with the other hand struck most members as dangerously close to outright contradiction. Most participants felt that God would not create an orderly world in which it was impossible for the creator to act without violating the created structures of order. (2004: 38)

This argument raises an important issue concerning the way that God is conceived in the theistic worldview. It is easy, when discussing the miraculous events attributed to God, to be lured into viewing Him as *only* acting in the world at such times. One thinks of the laws of nature as operating of their own accord (once God has set the universe in motion), with God occasionally stepping in to keep everything running smoothly. This kind of thinking is often associated with Newton's suggestion, having discovered the law of gravity, that God is still needed to adjust the orbits of the planets in order to prevent their decay (Ramati, 2001: 417). This kind of thinking has, however, received much criticism. As we saw in chapter two, Plantinga argued

that "god-of-the-gaps" theology was misguided because "God is constantly active in his creation" (1997: 150) and that natural laws should not be considered to be independent of God.

If Plantinga is correct in this assessment, then God should not be viewed as playing a causal role only when the laws of nature are violated, but as actively maintaining them *at all times*. But then, one may ask, is it incoherent or inconsistent to speak of God maintaining the laws of nature while at the same time violating them? According to Plantinga, not in any obvious way:

There would be arbitrariness and inconsistency only if God had no special reason for acting contrary to the usual regularities; but of course he might very well have such reasons. This is obvious for the case of raising Jesus from the dead: God intends to mark the special status accruing to Jesus by this mighty act of raising him from the dead. (2011: 106)

The notion that God does not act in an interventionist sense is not, however, limited to arguments regarding consistency. As theologian, philosopher and Anglican Priest John Macquarrie has been oft quoted: "The way of understanding miracle that appeals to breaks in the natural order and to supernatural intervention belongs to the mythological outlook and cannot commend itself in a post-mythological climate of thought" (1977: 248). This position should not be taken as denying that God is causally responsible for what we see in the world. God is still taken to act in a role of 'sustaining' or 'preserving' the natural order, but not 'interfering' with it. As Langdon Gilkey outlines a liberal theological position:

In understanding God's acts and speech literally and univocally, the orthodox belief in special revelation denied the reign of causal law in the phenomenal realm of space and time, or at least denied that reign of law had obtained in biblical days. To the liberals, therefore, this orthodox view of revelation represented a primitive, prescientific form of religion and should be modernized [...]. God's act's ceased to be special, particular, and concerned with phenomenal reality [...]. Rather, the divine activity became continual, creative, immanent activity of God. (1961: 194-195)

Thus we see that one can accept God as having a causal role in the events within the universe and yet also reject the notion that God miraculously intervenes in the

natural order. What is interesting to our discussion however is the description of this view as "prescientific". This account seems to adopt the position that science is not only capable of investigating supernatural phenomena understood as violations of the laws of nature, but that it has actively *disconfirmed* their occurrence. Astonishingly we find here an example of the anti-supernaturalist anti-separationist position, outlined in chapter one as being paradigmatically represented by Richard Dawkins, being advocated as a viable *theistic* position. Thus once again we see reason to reject the notion that the separationist outlook represents any plausible sense of a 'middle ground'.

Plantinga (2011) argues that such liberal theological attitudes are the result of commitment to the idea that modern science implies "hands-off theology" and further, that science is tied to a deterministic outlook which leaves no room for divine intervention. He suggests that such notions are the result of equating science with what he calls a "Laplacean" conception of the way the world is. By this he refers to a classical Newtonian understanding of the universe as a "vast machine evolving or operating according to fixed laws" (2011: 74-75) combined with the notion that the universe is causally closed. By combining these two notions we arrive at the idea that violations of the laws of nature cannot and do not happen because the conception does not allow for such events. He argues however, as we have seen already, that even granting the Newtonian picture, we have no reason from science to suppose that the universe *is* causally closed:

These principles, therefore, apply to *isolated* or *closed* systems. If so, however, there is nothing in them to prevent God from changing the velocity or direction of a particle. If he did so, obviously, energy would not be conserved in the system in question; but equally obviously, that system would not be closed, in which case the principle of conservation of energy would not apply to it. Indeed, there is nothing here to prevent God from miraculously parting the Red Sea, or changing water into wine, or bringing someone back to life, or, for that matter, creating *ex nihilo* a full-grown horse in the middle of Times Square. It is entirely possible for God to create a full-grown horse in the middle of Times Square without violating the principle of conservation of energy. (2011: 78-79)

If Plantinga is correct then no matter what conception of a law of nature we adopt, there would be no necessary contradiction in saying that it is a law, *L*, that not-*m*,

and also, m . The scope of L is limited to situations in which the universe is causally closed, but even the definition of a miracle suggested by Hume was appended by the important caveat "by a particular volition of the Deity, or by the interposition of some invisible agent" ([1777] 2004: 74). In the case of Christian theism, if the Deity in question is specially acting to bring about m then the universe is not causally closed and thus L is not applicable in that situation. God cannot violate the laws of nature because the laws of nature do not apply in situations where He is intervening.

There are a number of objections that may be raised against Plantinga's argument. Firstly, that this is a case of *special pleading*, or else a misconception of the universality of natural laws. To say that the laws of nature only apply to the limited, closed, system of the universe is simply to extend Nelson Goodman's pocket to the size of the universe. This criticism does not, however, seem entirely fair. The issue with Goodman's pocket was a question of limiting the scope of a law to a specific spatiotemporal location. Plantinga however is limiting the scope of a law to *space and time itself*. God, being transcendent, exists 'outside' of such boundaries, thus it is entirely coherent (so long as one accepts the coherence of transcendent existence) to say that the laws of nature are not spatiotemporally limited and yet still limited.

A second objection might echo the earlier concerns of the DAP conference. In what sense if, in Plantinga's words, "God is constantly active in his creation, that natural laws, if there are any, are not independent of God" (1997: 150), does it make sense to refer to the laws of nature as operating in a closed system? If God is constantly maintaining the laws of nature (or, on the more dramatic Occasionalist outlook, directly intervenes in *every* instance of causation), then how can one talk of a causally closed universe? In what situations could L ever be thought to apply if God is active in every situation?

Regarding the separationist debate, Plantinga's argument seems double-edged. On the one hand, by placing God outside of the closed system governed by natural laws, it gives us explicit reason to think that science cannot investigate acts of God, which as we have seen is the driving motivation behind much of the discussion surrounding

the issue. On the other hand, Plantinga has given us explicit reason to *reject* the notion that supernatural events violate laws of nature, which is one of the most explicit and consistent expressions of justification for the separationist position. If we accept Plantinga's argument then, while we might *want* to accept the separationist position, he has provided a devastating blow to a central tenet of it.

Even more problematic for the separationist position is the fact that neither natural laws nor violations of them are couched specifically in terms of Christian theism¹⁵. Even Hume's caveat was rendered religiously neutral by being framed as a disjunction ("or by the interposition of some invisible agent"). If we grant that the God of Christian theism (or transcendent deities in general) might be taken as legitimately operating outside of the scope of natural law, then this does not justify us extending the separationist principle to supernatural phenomena in general. Unless we define supernatural phenomena as specifically that which exists or originates beyond the boundaries of space and time (an idea discussed in chapter six), then there seems to be no obvious reason that we can extend Plantinga's reasoning to anything other than God Himself. Indeed, the majority of those phenomena which we would commonly refer to as supernatural (such as ghosts, ESP and astrology) seem entirely distinct from such a definition.

Conclusion

It seems then, that the notion of the supernatural as a violation of natural law is, if even coherent, an extremely poor motivation for a separationist position. Humean conceptions of natural law simply render the concept untenable, even on more sophisticated accounts. It cannot be the case both that there is some universal regularity which might constitute a law of nature, and also a truth which contradicts it. Where it is plausible to speak of a violation on a Humean account, this offers us

¹⁵ Unless one defines natural laws in explicit terms as deriving directly from God in some way, as in the form of a literal divine decree. However, if one adopts such an approach then the notion that science can not investigate supernatural phenomenon collapses even more swiftly into incoherence.

no reason to suppose that science cannot investigate and, more pressingly, we could not in many cases affirm that a violation has occurred without conducting such an investigation first.

The non-Humean accounts we have discussed, though perhaps more promising, fare little better. Though they offer potential avenues for us to make true claims regarding both the existence of natural laws and violating instances of them, they do so in a way that makes it plain that such violations are entirely within the remit of scientific investigation. Indeed, establishing what these laws are, and when they have been violated, requires science to investigate.

We have not discussed every conception of natural law in the philosophy of science, nor is it impossible to rule out any future conceptions that might allow us to make sense of the notion. However, the failure of primary modern accounts is sufficient to render the separationist position highly suspect if defended on such grounds. On any account of natural law that might be deemed widely accepted enough to inform, for instance, legal decisions regarding what constitutes science, we cannot make any sense of the notion that the supernatural is that which violates it in a way that implies exclusion from scientific investigation. On any account that fails to garner such acceptance, there is little justification for appealing to it in order to defend maintaining the separationist position in the spheres of scientific or legal communities. While this kind of approach offers interesting scope for philosophical research then, it cannot be accepted at present.

Pursuantly, as we have seen in our brief insight into religious approaches to the topic, the notion that supernatural phenomena involve violations of the laws of nature seems at best controversial. Even if we were successful in constructing a concept of natural law which could meaningfully be considered violable in a way not amenable to scientific investigation, many in the religious community would not consider God to act in a way that violated it. If we find ourselves in a position where not only is our understanding of natural law esoteric, but our conception of the supernatural does not apply to the God of Christian theism, then it seems that we

have strayed far beyond the point where such terminology can be employed in the kind of cultural discussions raised in chapter one.

Chapter 5

Scientific methodology and the supernatural

The notion of a 'scientific method' is common in both the philosophical literature and the popular zeitgeist. As in previous chapters, I shall spend little time here discussing whether or not any such method actually exists, or whether it unites the sciences. Rather, as with the approach to natural law in chapter four we shall address major potential conceptions of scientific methodology in turn, and examine them in relation to the supernatural. Before engaging in the discussion proper however, I shall return to the issue raised earlier of defining the supernatural in terms of that which science cannot investigate. As this is one of the most promising conceptions of the notion we have addressed, it is worth taking note of again, even though as before, it is simply untenable in the context of separationism.

This chapter is broadly structured historically, and the first major discussion point we shall turn to is Popperian falsifiability. This is a natural starting point due to its prevalence and historical location in the demarcation debate, as well as the natural relationship between science and 'testing'. This will entail a brief outline of the concept, followed by relating it more explicitly to supernaturalism via commentary from Pennock. Following on from this we shall address two issues raised by Kuhn: the notion that science operates in periods of "normal science" and "revolutionary science"; and the idea that science can be demarcated from pseudoscience due to its ability to "problem solve". In each case, it is determined that no impediment to investigation of the supernatural seems to arise.

After discussing the work of Kuhn we shall move on to the idea of "sophisticated falsification", forwarded by Imre Lakatos, with a particular emphasis on novel prediction. Although again no conflict is identified between Lakatos' views on scientific method and investigation of the supernatural, we do see here a potentially interesting reason why creationism in its current state may be deemed unscientific.

The final two approaches to scientific method present a more sceptical approach to the notion of science possessing some necessary or sufficient criteria which set it apart. The first, forwarded by Paul Feyerabend, is the more opposed to the notion of a defined scientific method, although he does present an idea of how we might meaningfully distinguish true scientists from "cranks" (1981: 199) in a way that has useful bearing on our discussion. The second, offered by Paul Hoyningen-Huene, offers a more optimistic approach to demarcation, though not one which offers any weight to the separationist position.

A preliminary aside

Before discussing the various methodological criteria that have been proposed over the course of the demarcation debate, it is worth reemphasising a point made in chapter three about a specific issue regarding the supernatural and our understanding of scientific method. One can, of course, define the 'supernatural' as that which is untestable or unfalsifiable. Indeed, Pennock, in defending the *Kitzmiller* result, seems to imply such a definition:

The [...] misunderstanding arises [...] with ID proponents and even some opponents (typically supporters of metaphysical naturalism), claiming that science can indeed test the supernatural. This confusion often seems to turn on an inadvertent naturalizing of the supernatural, such as treating creationist hypotheses as though they were meant in the ordinary way. For instance, both Laudan and Quinn cite the young-earth creationist view that God created the earth 6,000 to 10,000 years ago as a hypothesis that is testable and found to be false. But this and other examples that are offered to show the possibility of tests of the supernatural invariably build in naturalistic assumptions that creationists do not share. (2009: 550)

Such an understanding does provide a potentially valid reason to exclude the supernatural from scientific investigation. If the supernatural is simply understood as that which is untestable or unfalsifiable, then this offers a *prima facie* justification for arguing that science cannot investigate it. However, this is simply a more specific form of our earlier problem regarding defining the supernatural as "that which

cannot be investigated by science". While testability or falsifiability may feature in some plausible definition of supernaturality, such a definition is fatally circular when forwarding a prescriptive separationist position.

We can coherently, and perhaps even sensibly, accept such a definition for the supernatural. By defining the supernatural as that which lies beyond scientific investigation we would not only arrive at a coherent picture of exactly what differentiates natural and supernatural phenomena, but we would also do justice to the prevalent intuition that science and religion operate in accordance with something like Gould's conception of non-overlapping magisteria¹⁶. A phenomenon would be supernatural if it is determined to be untestable and/or unfalsifiable. Not only does such a criterion align with Gould's intuitions, but it also seems to be one of the few – if not the only – unifying and exclusive traits that can be plausibly attributed to so diverse a set as astrological phenomena, goblins and the God of Western theism.

In this form however, the criterion is far too weak to adequately capture our intuitions regarding what it means for something to be 'supernatural'. If taken at face value, then this account would imply that Russell's teapot, the disappearance of Amelia Earhart, and potentially the entirety of the unobservable universe are 'supernatural'. We must, therefore, be careful to strengthen our criterion such that a phenomenon is supernatural only if there is no *nomically possible* world in which it is testable or falsifiable. Russell's teapot could, given a sufficiently powerful and well-located telescope, be so tested. The fate of Amelia Earhart could be ascertained if the wreckage of her plane were discovered. The 'unobservable' parts of the universe could be rendered observable by means of a suitably located observer.

¹⁶ Though it should be noted that this would conflict with Gould's suggestion that there were other magisteria, such as Art, unless further steps are taken to differentiate the artistic and the religious spheres.

I do not wish to overly endorse this conception of the supernatural, partly because it would exclude too many intuitively supernatural phenomena (in its stronger form, both astrology and goblins would be rendered non-supernatural), and partly because it seems to reduce the supernatural to an overly relative conception, to use Clarke's terminology. Even the theistic God, taken to exist transcendent to the universe, is only supernatural by virtue of the fact that we as observers are not. If we were capable of observing beyond the spatiotemporal manifold in which we exist and "gaze upon the face of God", then He would no longer constitute a supernatural entity.

These considerations aside, the most fundamental problem with this conception of the supernatural as it pertains to our discussion is that it offers no *independent* reason for endorsing a separationist position regarding science and the supernatural. If some phenomenon is untestable or unfalsifiable, and either of these criteria is necessary for scientific investigation, then that phenomenon is not scientific. However, it is of no consequence, nor is it informative, to say that this phenomenon is *also* supernatural. By noting that the phenomenon is untestable or unfalsifiable we already have all of the information that we need in order to determine its status as unscientific, and that this also renders that phenomenon supernatural is irrelevant to the discussion. Most troublingly, to assert that some phenomenon is outside of the domain of science *because* it is supernatural is to construe the relationship entirely in reverse. The phenomenon, on this account, is not unscientific because it is supernatural, *it is supernatural because it is unscientific*.

We should note that Pennock argues that methodological naturalism does not operate in science in such a seemingly arbitrary and confused manner. We do not simply declare that supernatural phenomena and hypotheses are outside of the scope of scientific enquiry, but rather through reasoned argument (such as by arguing that supernatural phenomena are untestable or unfalsifiable), and thus while they are excluded by virtue of being supernatural, he potentially avoids the charge of circularity that I am levelling here:

Does science put forward the methodological principle not to appeal to supernatural powers or divine agency simply on authority? Is it just an extravagant, arbitrary, speculative assumption? Certainly not. There is a simple and sound rationale for the principle based upon the requirements of scientific evidence. (Pennock, 1996: 552)

While these considerations may seem obvious, it is important to bear them in mind. We might be confident that we should never simply assert that supernatural phenomena should be excluded from science, nor fall into the circularity outlined here, but we must take pains not to be lured into such a position through habit or carelessness. If the supernatural truly does not belong within the sphere of science, then we must be clear about both what it is we mean by supernatural, and for what reason such phenomena are beyond scientific investigation. Let us now turn our attention towards some notable examples of attempts to outline such reasons.

Testability, confirmation and Popperian falsifiability

We have encountered the notion of testability and falsification several times over the course of this discussion. This should come as no surprise given how deeply the concept of 'science' is entwined with the notion of 'testing' and 'experiment'. Of the five explicit criteria for science that Ruse and Overton outlined during the *McLean* case, two of them directly referenced this point. Pennock also defended such a position in his testimony at the *Kitzmiller* trial (2006: 457). Indeed, the role of testability has had much attention throughout the 20th and 21st centuries following the claims of the Logical Positivists that the only meaningful statements were those which were analytic or which could be verified empirically (Ayer, [1936] 1952: 9). In this section we shall briefly discuss the concept once more in a general sense, this time with a deeper focus on Popper and Pennock, before discussing the concept in terms of our established potential conceptions of the 'supernatural'.

The work of Karl Popper on falsification has received a great deal of attention in the demarcation debate. On a general level, Popper emphasised the notion that

scientific theories need to be open to revision (reflected in Ruse's "tentativeness" criterion discussed in chapter two): "Popper alleges that advocates of supposed sciences such as Freudian and Adlerian psychology and Marxism, are defensive or evasive when it comes to dealing with difficulties for their theories; they shun openness to revision and adopt an uncritical approach to their subject" (Nola and Sankey, 2007: 253). This emphasis on revision and tentativeness places a high degree of importance on a theory's ability to be disconfirmed by evidence.

In *The Logic of Scientific Discovery*, Popper introduced the concept of a "basic statement". A basic statement, he says, "is a statement which can serve as a premise in an empirical falsification; in brief, a statement of singular fact" ([1935] 2002: 7). Popper goes further here and distinguishes basic statements into two categories, those which are compatible with a theory, and those which are not:

A theory is to be called 'empirical' or 'falsifiable' if it divides the class of all possible basic statements unambiguously into the following two non-empty sub-classes. First, the class of all those basic statements with which it is inconsistent (or which it rules out, or prohibits): we call this the class of *potential falsifiers* of the theory; and secondly, the class of those basic statements which it does not contradict (or which it 'permits'). We can put this more briefly by saying: a theory is falsifiable if the class of its potential falsifiers is not empty. ([1935] 2002: 65-66)

It is worth noting here that there is an asymmetry between confirmation and falsification. The problem with confirmation is that an instance of apparently supporting evidence for a theory, even a surprising one (which we shall discuss shortly), does not confirm a theory as true. This problem is exacerbated by other famous concerns such as Hume's problem of induction ([1739] 2003: 247) and Hempel's raven paradox (1945: 11), though we do not have space to discuss such issues satisfactorily here. For now we should merely note that if we express some law of the form "If P, then Q", then any instance of both P and Q will not confirm that theory, whereas any instance of P and not-Q will disconfirm it. Hence the emphasis on falsification, rather than confirmation, in Popper's demarcation.

It is also relevant that for Popper a theory must contain potentially observable content in order to be classed as scientific. There must be some potentially observable basic fact in the class of statements inconsistent with the theory¹⁷. That a theory does not contain such facts is not, at least superficially, a criticism of the theory, but it does determine that the theory is not scientific. This applies not only to purported 'pseudosciences', but to many respected areas of thought:

In this category will be found propositions that are mathematical, definitional, analytic or metaphysical including influential metaphysical theories that are proto-scientific in that there is at the time no known way of bringing them into relation with anything we could observe (such as ancient Greek atomism or aspects of Freudian psychology). (Nola and Sankey, 2007: 257)

Falsification and the supernatural

What then, can be said of the claim that supernatural phenomena and hypotheses are untestable in the sense described by Popper? Pennock argues that claims regarding the existence of such phenomena, specifically those made by creationists, are untestable due to the nature of God: "A god that is all-powerful and whose will is inscrutable can be called upon to 'explain' any event in any situation [...]. Leaving the designer unnamed and undescribed has the same effect." (2006: 472).

This is, at least *prima facie*, a reasonable criticism of creationism. There is arguably no basic statement that is inconsistent with the existence of an omnipotent being, by virtue of that being's omnipotence. However, as we have seen in previous chapters, Laudan has argued against the idea that we can reasonably treat such an issue in isolation; if we are seeking a basic statement that is inconsistent with the premise "there exists an omnipotent being", then we will be left empty-handed. As Pennock argues the general case:

¹⁷ It is worth observing that Popper's account allows for not only falsifiable but *falsified* theories to be considered within the domain of science. Pennock's argument discussed in chapter two that creationism, like geocentrism, has been rendered unscientific by disconfirmation, does not necessarily hold here.

Supernatural theories [...] can give no guidance about what follows or does not follow from their supernatural components. For instance, nothing definite can be said about the processes that would connect a given effect with the will of the supernatural agent – God may simply say the word and zap anything into or out of existence. Furthermore, in any situation, any pattern (or lack of pattern) of data is compatible with the general hypothesis of a supernatural agent unconstrained by natural law. (1996: 553)

However, as Pennock immediately acknowledges, this is not the whole story. Even creationists do not simply argue that "an omnipotent being exists", but rather make a whole host of claims, some of which seem to be inconsistent with possible basic statements:

Creation-Science does include supernatural views at its core that are not testable and it was rightly dismissed as not being scientific because of these in the Arkansas court case, but it at least was candid about a few specific non-supernatural claims that are open to disconfirmation (and indeed that have been disconfirmed), such as that the earth is less than 10,000 years old and that many geological and paleontological features were caused by a universal flood (the Noachian Deluge). (1996: 553)

Pennock's distinction between supernatural and non-supernatural views here is interesting. Remember that in chapter two we saw that for Pennock the "first and most basic characteristic of supernatural agents and powers is that they are above and beyond the natural world and its agents and powers. Indeed, this is the very definition of the term. They are not constrained by natural laws or chance processes" (2006: 471). It seems then that the distinguishing factor for Pennock here is that a phenomenon is supernatural *iff* it exists "above and beyond" the natural world not in a loose sense, but in an absolute one. God, existing above and beyond the natural world is supernatural, but events such as the Noachian flood, even if this were an event that was the result of direct intervention by God, are not. Thus, whilst the occurrence of the Noachian flood falls within the remit of scientific investigation, God Himself does not. Thus one might understand Pennock as arguing for the weak form of separation outlined previously.

Whilst this distinction may be a valid one, the application here suffers from two major problems. Firstly, it at least requires further elaboration as to why indirect

inferences to God from observable phenomena are prohibited in scientific methodology, whereas indirect inferences to countless other unobservable phenomena are not¹⁸. This is no small issue given that Pennock's conception of the 'supernatural' hinges on the already questionable notion of 'natural law' discussed in the previous chapter. Pennock hints at an answer:

Empirical testing relies fundamentally upon use of the lawful regularities of nature that science has been able to discover and sometimes codify in natural laws. For example, telescopic observations implicitly depend upon the laws governing optical phenomena. If we could not rely upon these laws – if, for example, even when under the same conditions, telescopes occasionally magnified properly and at other occasions produced various distortions dependent, say, upon the whims of some supernatural entity – we could not trust telescopic observations as evidence. (1996: 552)

The argument here seems to be that supernatural phenomena behave entirely (or at least often enough to prevent reliable prediction) erratically and unpredictably. Unlike say, electrons, which cannot be observed directly, but fall within the domain of scientific investigation via indirect observation, supernatural phenomena do not adhere to predictable natural laws. But then, as I have argued in previous chapters, if we are not able to investigate any supposedly supernatural phenomena scientifically, by what means have we arrived at the conclusion that they are unpredictable in this way? Even more problematically, if we define the supernatural in terms of natural law, how can we non-circularly differentiate between which phenomena or hypotheses are investigable by science (those which operate according to predictable natural laws), and those which are not (those which do not operate according to the same laws) prior to scientific investigation?

Additionally, in order to meaningfully apply this distinction we need to restrict ourselves to an unreasonably limiting understanding of what it is for a claim to be supernatural. While it might well be the case that there is no basic statement which is inconsistent with the proposition "an omnipotent being exists", there are many such statements which are inconsistent with the proposition "an omnipotent being

¹⁸ As discussed in chapter two, even on an anti-realist account, scientific theories still make reference to unobservables.

created the universe 10,000 years ago"¹⁹. Pennock differentiates between two extremes: statements which contain *only* references to 'supernatural' (on his terminology) phenomena; and statements which contain *no* references to 'supernatural' phenomena, but such a binary approach reflects neither the possible range of hypotheses available to the supernaturalist, nor the actual range of hypotheses that have been forwarded. As Pennock himself acknowledged, creationists claim that the Earth was created six to ten thousand years ago by an omnipotent deity. While he may be correct that testing this requires us to "build in naturalistic assumptions that creationists do not share" (2009: 550), this is simply irrelevant to the question of whether or not scientists are able to investigate it.

In Pennock's defence, his intended target here is creationism as presented by the Intelligent Design movement and the associated legalistic and rhetorical tactics they have employed. Even if there are possible and actual propositions that contain both supernatural elements and are also incompatible with at least one basic statement, these statements have been largely avoided by the ID community. This is in fact a large part of Pennock's criticism, and seems to inform much of his argument: "Confronted with evidence for an ancient earth, creation scientists dismiss the relevance of any such observations on the ground that God simply made the earth *appear* to be old" (2009: 550).

While this is a fair assessment of much of the state of the debate, this analysis simply reinforces the dichotomy of extremes Pennock wants to set up: a hypothesis that is not open to falsification in the way described here is not a scientific hypothesis because there are no basic statements which could possibly be incompatible with it. But this is not an issue with supernaturality, but rather an issue with explaining the discovery of falsifying evidence with an appeal to merely 'appearing' to be falsified. Certainly if we allow for the possibility that the truth value of any proposition is utterly unrelated to any empirical evidence we might find regarding it, then no

¹⁹ This is even granting Pennock's conception of the supernatural as existing "above and beyond" the natural world. If we grant that creatures such as goblins, vampires and unicorns can rightly be considered supernatural, then the list of falsifiable statements regarding them grows exponentially.

scientific activity could occur. However, the assumption that we should not allow for such severe scepticism seems far more fundamental than anything regarding the supernatural. As Evan Fales argues: "If that sort of skepticism is in play, then why worry about the occasional machinations of a god? The skeptic, in any case, will demand an answer to the much more fundamental question by what right we assume the operation, ever, of lawful natural regularities." (2013: 253).

At a more superficial level, even if we grant that certain theistic outlooks cannot be falsified due to the possibility that God can make any true fact appear to be false, this does not give us reason to exclude theistic hypotheses in general, let alone supernatural ones. Popper's demarcation criterion for a theory to be scientific demanded that there be some basic statement that was inconsistent with that theory. If there is no such basic statement regarding the notion that "an omnipotent being created the universe 10,000 years ago" since it is always possible that God made the universe appear as if it was not 10,000 years old, then we simply need to posit a stronger hypothesis in order to avoid this problem: "an omnipotent being created the universe 10,000 years ago and did not make it appear otherwise". This revised hypothesis, despite containing identical supernatural features, is now falsifiable in a way that the former is not, and therefore scientific on Popper's account in a way that the former is not. That creationists have hitherto avoided such commitments in formulating their theories does not diminish the fact that, once again, we see that supernaturalism is irrelevant to the question of demarcation.

Alternative conceptions of the supernatural

While Pennock's objections to the falsifiability of creationism may not hold, perhaps some of our other conceptions of supernaturalism do present difficulties. We saw in chapter three that numerous potential definitions were available, including "that which violates natural law", "disembodied minds", and "that which lies beyond space and time". It seems however that our analysis of Pennock's argument provides us

with ample solutions regarding these criteria as well. Let us briefly examine these notions in turn.

We have seen that attempting to cash out supernaturalism in terms of natural law is a task beset with problems, but even if we grant that it is possible to make sense of such a notion, this does not seem obviously to prohibit the construction of falsification criteria. If we assume that whatever interactions occur in the workings of astrology are not, in any meaningful sense, in accordance with natural law, then this does not prevent us from applying the laws of *logic* to them in constructing criteria. If it were claimed, for example, that "Capricorns are hard workers", then this offers us an entirely testable piece of information. Whatever relations are at play *underneath* this correlation, natural or otherwise, have no bearing on our ability to make testable predictions. Indeed, suggesting that we need to understand such relations, or that they even exist, commits us to a very specific and controversial set of conceptions of natural law that is by no means an accepted prerequisite for science.

The notion that the supernatural involves disembodied minds does not fare any better. Indeed, all of our discussion of an omnipotent being, in the context of creationism, implicitly assumes such an entity is being discussed. In other areas, the disembodiment of the mind seems an almost extraneous issue in constructing a hypothesis. If one posits agency, as one might in the case of investigating a mysterious death, or upon discovering some archaeological artefact, then the question of whether or not said agency is embodied does not come into discussion. Of course, we will generally assume that said agency was embodied, and that embodiment might even factor into a more complete explanation (say in explaining the method of committing a murder, or in the crafting of a piece of pottery), but we have no more need to know 'how' some agent-orchestrated act occurred in order to posit agency than we need to know 'how' gravity works in order to posit attraction between massive bodies.

One might be tempted here to appeal to a classic response to design arguments (Hume [1779] 1993: 46) that the reason we can infer a murderer, or a potter, or a painter, or a house builder, is that we have *experience* of murderers, potters, painters and house builders. Thus the analogy regarding other scientific appeals to agency fails because we have experience of natural agents, but not supernatural ones. However this is where we can make an important distinction between genuinely scientific appeals to the supernatural, and unscientific appeals (or otherwise non-scientific references) to the same. As we have acknowledged, the claim that "an omnipotent being exists" is not scientific on a Popperian outlook. However, by adding relevantly testable criteria to the claim, we are able to render it properly scientific.

This distinction is perhaps best exemplified by observing the discussion surrounding the various problems of evil. The classic formulation by Epicurus²⁰ lays the foundation for an entirely Popperian research program. The hypothesis is that there exists some entity who is capable of preventing evil, and willing to do so. This presents us with the possible and inconsistent basic statement that "evil exists" as a testable prediction. However, as has been seen over centuries of theodicies there has been much in the way of objection to the idea that the absence of evil is a logical consequence of the existence of an omni-attributed being. Pennock's description of the behaviour of young earth creationists can, to a degree, be mapped onto such discussions. As Pigliucci argues:

When a young-earth creationist is faced with geological evidence of an old earth, he has several retorts that seem completely logical to him, even though they actually represent the very reasons why creationism is a pseudoscience: the methods used to date rocks are flawed (for reasons that remain unexplained); the laws of physics have changed over time (without any evidence to support the suggestion); or God simply created a world that *looks* like it is old so that He could test our faith (called "last Thursday" defense, which deserves no additional commentary). (2013: 16)

²⁰ See, for example, Noddings: "[I]f God could have prevented evil and did not, he is malevolent; if God would have prevented evil but could not, he is impotent; if God could not and would not, why call him God?" (2003: 438).

However, and this is a crucial point regarding the overarching thesis of our discussion, there is a key difference between the behaviour of creationists and those defending their beliefs against the problem of evil. Proponents of theodicies are not forwarding, nor claiming to forward, any kind of scientific hypothesis. The claim that "God exists" is not being treated as a scientific claim as understood on a Popperian schema. It is not falsifiable, as Pennock has argued, because it is taken to be compatible with all possible basic statements. However, while "an omnipotent being exists" is not necessarily a scientific claim, this does not mean that it cannot be incorporated into a scientific claim. The idea that there exists an omnipotent being may not be falsifiable, but the notion that "there exists an omnipotent being *whose existence is incompatible with both evil and the appearance of evil*" (at least defensibly) is falsifiable²¹.

Again, we see that the supernaturality of a claim is irrelevant to its scientific investigability. Certainly a proposition with no apparent falsification criteria ("somewhere in space, there is a lump of gold that weighs exactly one ounce") will be, at least for practical purposes, unfalsifiable. That creationists, or even theists in general, have not provided hypotheses which fit the Popperian scientific model, is of no consequence. As we noted in chapter one, and will discuss again in chapter seven, there are many theists (for example the pro-supernatural, pro-separationists) who have no desire whatsoever to do so. Moreover, that thus far the most prominent anti-separationist theists in the science/religion controversies have declined to provide any such hypothesis is similarly unimportant.

We can, to further this line of thought, modify the falsification criteria so that it demands active attempts at falsification in order for a program to be deemed scientific. As Boudry argues: "To give the Popperian demarcation criterion some teeth, we need only require that, in addition to being falsifiable, a theory must have survived repeated attempts at falsification (the Popperian notion of 'corroboration'). The fact that young-earth creationism is technically 'scientific' for a strict Popperian,

²¹ So long as a suitably rigid definition of evil is provided. This is, admittedly, a proposition whose meaning is much more philosophically controversial than "the Earth is 10,000 years old".

in the sense that it is at least open to falsification, even though having been conclusively falsified, is a semantic nonissue." (2013: 83). If we accept this reasoning, then we can avoid concerns over both the scientific status of creationism due to its potential falsifiability, and also accommodate theists with no interest in appearing scientific. Creationism, or any other attempt at scientific theory, would only qualify upon sincere attempt at falsification. That creationism has thus far failed to meet this requirement, and that many theists have no interest in meeting it at all, is at least in principle irrelevant to the supernatural content of the proposals involved.

The final conception of the supernatural, that which exists beyond space and time, shall be addressed in more detail in chapter six along with further discussion of both design inferences and the problem of evil, though for now it provides a useful opportunity to note an important general issue with supernatural hypotheses. One might be inclined to argue that supernatural phenomena, being beyond the scope of empirical testing, are clearly beyond the realm of empirical science. Indeed, this final conception of the supernatural renders this intuition almost tautologous. If the supernatural is defined as that which is beyond the boundaries of space and time then it seems self-evident that we cannot investigate it. This objection however is subject to two distinct problems.

The first, and most obvious, problem with this argument is that not all intuitively supernatural phenomena are thought to exist beyond space and time. Ghosts, goblins, psychics, and all manner of other phenomena exist, at least in part, within the boundaries of the space-time manifold. Even God, especially within Christian tradition, is often thought to exist partially in this manner. Thus it seems absurd, at best, to discount the supernatural from science on such a basis.

The second, and more complicated, problem is that even if supernatural phenomena do exist beyond space and time, their effects do not. We might, in order to defend weak separationism, argue that there are some issues with inferring information about a transcendent being from *purely* non-transcendent empirical information.

However, when we consider actual theistic claims, no such inferences are required. We are not dealing with the Humean problem of inferring a designer of a particular type, whilst having no previous experience of that same type. Theists are not in general starting from a blank philosophical slate and attempting to reason information about God blind, but instead bring much in the way of doctrinal, traditional and revelatory information to the table. The theist is not forced to infer a designer solely from the evidence, but can instead posit a designer (with various attributes) and test predictions based on that hypothesis.

Even though there is no need to rely on purely non-transcendent empirical information in constructing testable hypotheses, many such attempts have been proposed. Arguments from design have often at least ostensibly operated in this manner, though the history of creationism outlined in chapter one illustrates the blurriness of this claim. Leaving such complications aside however, it is conceivable that in the absence of pre-existing theistic belief that a design inference from observation of the complexity or beauty of the natural world might be made. Moreover, it is also conceivable that falsifiable predictions could be constructed from a suitably fleshed out hypothesis of that nature. We will discuss these kinds of natural theological arguments in the following chapter.

Kuhn – Paradigm shifts and problem solving

Kuhn argued that Popperian falsification was something that only described scientific method in very rare circumstances. He argued that Popper had "characterized the entire scientific enterprise in terms that only apply to its occasional revolutionary parts" (1974: 803). Though Kuhn articulated several characteristics which he thought described good scientific theory²², there are two distinct, though related, aspects of Kuhn's work which are relevant to our discussion. The first is his famous discussion in *The Structure of Scientific Revolution* (1962), on the idea that the

²² See Kuhn 1977: 320-339.

dominant scientific theories and methodologies of a period of science represent "paradigms" which can be replaced in a periods of great upheaval. The second, is his more specific commentary on science as a "puzzle solving" activity.

Under Kuhn's analysis, scientific theories are not, in periods of "normal science", subject to heavy scrutiny or criticism in the sense of attempting to falsify them. Evidences which appear to be incompatible with any particular theory, rather than taken as a potential falsifier of that theory, are taken as "problems" to be solved. It is only when such problems become too overwhelming that a "crisis" period emerges, and alternative theories are proposed and actively considered as viable alternatives.

We briefly considered in chapter two the possibility that one might adopt a Kuhnian analysis in discussing methodological naturalism, with the naturalistic position taken to be part of the current paradigm, and supernatural hypotheses thus falling outside of current scientific discussion. We might, less controversially, also understand the evolution versus creationism division in this way. If one takes evolutionary theory to represent the dominant theory of the current paradigm (as one undoubtedly should), then creationism, interpreted in a way that contradicts evolutionary theory, might be considered 'unscientific' in the sense of falling outside of that paradigm. This echoes, to an extent, Pennock's suggestion that creationism is 'unscientific' in the same way that geocentrism is unscientific, albeit in a much more particular manner. Additionally, it would highlight the reason that much of the 'evidence' for Intelligent Design, largely comprising apparent flaws with evolutionary theory, has failed to take purchase within the scientific community. Even if evidence for something like Behe's "irreducible complexity" is presented, it is at this stage far more likely to be taken as a problem to be solved than as evidence that the entire theoretical framework should be overturned.

There are, however, two major obstacles to utilizing such an approach in defending a separationist position regarding the supernatural. Firstly, it adopts such a stringent definition of 'scientific' as to rule out not only creationism and geocentrism, but also

any historical theories which have been subsequently replaced by more modern viewpoints such as Newtonian mechanics, as well as any modern hypothesis which falls outside of the accepted paradigm. While this may be a reasonable move from a position of philosophical abstraction, and creationism certainly falls outside of the current scientific paradigm, it fails to capture the sentiments of a separationist position presented in chapter one. To say that creationism is incompatible with the prevailing scientific paradigm is not to say that science and religion occupy distinct non-overlapping spheres of thought, but rather to say that scientific consensus has determined this particular religious claim to be false.

The second problem for such an approach is that while we might accept evolutionary theory as intrinsic to the current paradigm, it is not so clear that this is also true for either metaphysical or methodological naturalism. Although, as we continue to touch on throughout our discussion, there have been several suggested reasons as to why one might take methodological naturalism to constitute an important aspect of current scientific methodology, and thus reasonably interpret it as part of the current paradigm, this is not something that can be derived purely from the accepted truth of evolutionary theory, and therefore the accepted falsehood of creationism. It does not follow from a rejection of creationism that we can reject all supernatural phenomena, even if one could construct an argument to exclude the former.

More problematically, even if we *could* conclude that naturalism was a tenet of the current scientific paradigm from a rejection of creationism (or from any other scientific theory), then this would construe the reasoning exemplified by separationist opposition to creationism backwards. We cannot reject creationism from the scientific world because it contains supernatural elements, and then non-circularly reason that supernaturalism is not part of science from any argument containing the premise that "creationism is not scientific". This applies not only to the simplistic argument considered here, but also to cumulative cases built upon observation of general rejection of supernatural phenomena in scientific theory. For example, as Pennock claims:

Put simply, the argument was that as a point of method science does not countenance appeals to the supernatural. Again, we did not claim *only* science requires this ground rule [...]. Suffice to say that no judge would take seriously a plaintiff who sought damages against someone for laying a curse upon his car or a defendant who pleaded innocent on the grounds that the crime had actually been committed by a ghost. A lawyer would be laughed out of court who argued that judges and juries should consider "alternative theories" that a crime was committed by a supernatural intelligence. The IDC's call for a "theistic science" is similarly unworkable. (2009: 546)

While I am inclined to agree with Pennock that both inside and outside of the scientific community there is a hostility and dismissiveness towards supernatural hypotheses, we cannot non-circularly use this reasoning as a basis for separationism. It is of no philosophical consequence that scientists do not accept supernatural hypotheses if it turns out that their reason for doing so is based upon the observation that scientists do not accept supernatural hypotheses.

The second important aspect of Kuhn's work that is relevant to our discussion is his emphasis on "puzzle solving". Kuhn argued that it is this puzzle solving aspect of science which allows us to demarcate the pseudosciences. He uses the example of astrology in particular and contrasts it with astronomy, which he considers genuine science. He argues that only the astronomer is able to adjust their theory in light of new evidence, or to do further research in order to accommodate a problem. Conversely, a problem encountered in astrology could not be treated as a puzzle to be solved because "no man, however skilled, could make use of them in a constructive attempt to revise the astrological tradition" (1974: 804).

I am not convinced that the puzzle solving criterion is sufficient to exclude astrology from the domain of science, but even if it did, it does not seem that it could be successfully extended to all supernatural claims. If creationist ideas were correct, then the fact that we do not find an evenly distributed fossil record across all strata should provide a perfectly soluble puzzle. Why, if all life was created simultaneously within the last 10,000 years, do we find fossils to be distributed according to the geological layers, as if they had been laid down at different points in time? Further research might provide geological or theological reasons for the apparently stratified

history of life, and indeed, creationists have attempted to answer this question via appeal to the Noahian flood:

The 'fountains of the great deep' (Gen. 7:11) would logically have buried small seafloor creatures first. Water plants would generally be buried before coastal and mountain plants. Land creatures would be buried last, especially the mammals and birds that could escape to higher ground. The more intelligent creatures would find a way to escape until the very end, leaving their bodies nearer the surface, where post-Flood erosion would destroy most evidence of their existence. Humans would have been most resilient of all, clinging to debris and rafts, before they died of exposure; their floating bodies would have made easy meals for scavenging fish, so would not have fossilized as readily. Most mammal and human fossils are post-Flood. (Sarfati 2002: 129).

Of course we are free to disagree with this specific creationist argument, but we can only assume that no creationist could solve the problem of fossil distribution if we assume that creationism is false. If we wish to avoid presenting this as assumption then we would be forced to counter this claim with evidence. However, whilst demonstrating that creationism is not evidentially supported would certainly disqualify it from becoming accepted scientific theory, we could only show it to be so unsupported if it *had* been scientifically investigated. Once again, creationism is perfectly within the realm of scientific investigation, it just so happens that such investigation has led the scientific community to reject it. Thus the separationist appealing to Kuhn finds themselves with an impossible task, either we must assume that creationism is false in order to assert that it is not scientifically investigable, or else we must investigate it in order to demonstrate that it is false. Either way, they are not advocating a scenario in which science is taken to be mute on the subject.

Lakatos and scientific research programs

Lakatos argued that the Popperian approach was naive on the grounds that the distinction between a scientific theory and a pseudoscientific theory cannot be that the former is open to refutation because, to some extent, all theories are falsified. "Contrary to Popper, the difference cannot be that some are still unrefuted while

others are already refuted. When Newton published his *Principia*, it was common knowledge that it could not properly explain even the motion of the moon; in fact, lunar motion refuted Newton." (Lakatos, 1973: 24). In light of this, he offered a revised system of "sophisticated falsification".

Lakatos suggested that science be viewed in terms of "research programmes" (1969: 167). Echoing Kuhn's notion of competing paradigms, a scientific research program consists of a "hard core" of fundamental postulates which are taken to be true, a set of heuristics for developing the programme, and any auxiliary assumptions which follow from these, but can be altered upon refutation (Nola and Sankey, 2007: 274-275). These programmes are reconstructed historically, rather than being actively recognised by those within them. Even the hard core of beliefs need not be held by their practitioners: "Prout never articulated the 'Proutian programme': the Proutian programme is not Prout's programme" (Lakatos, 1978: 119).

Relevant to our discussion, theoretical stages within scientific research programmes can be differentiated in terms of the novel consequences of a theory. If we consider two theoretical stages, T_1 and T_2 , then T_2 can be identified as subsequent and distinct to T_1 if it contains some novel consequences that T_1 does not. Most simply, but not exhaustively, this can be understood in terms of novel predictions. If there is some logical consequence of the laws and empirical content of T_2 that is not found in T_1 , then T_2 represents a new theoretical stage with novel content. If these consequences turn out upon investigation to be true, then T_2 has predicted a novel fact. In Lakatos' terms, such a series is "theoretically progressive" (1978: 33).

It is not necessarily the case that a novel fact need be unknown prior to being posited in order to function as a confirming piece of evidence. Though this is a matter for discussion which shall not be elaborated upon here, one can arguably consider a piece of known information to be confirming evidence for a theory if that information was not included in the construction of that theory, or was not something which the theory was intended to explain, for example: "the missing 43 arc-seconds per century in the precession of the perihelion of Mercury. This fact,

well known from the middle of the nineteenth century, remained unexplained for some time until it received its first generally acceptable explanation in late 1915 when Einstein introduced his general theory of relativity." (Nola and Sankey, 2007: 278). Whether or not this counts as confirmatory of Einstein's theory depends on whether one takes the historical context of the theory into account, rather than consider the theory's logical relation to facts in isolation.

From a demarcation perspective, there are a number of issues to unpack here. Firstly, Lakatos' demarcation criterion applies to series of theories, not theories themselves. As he articulates the point:

Sophisticated falsificationism thus shifts the problem of how to appraise *theories* to the problem of how to appraise *series of theories*. Not an isolated *theory*, but only a series of theories can be said to be scientific or unscientific: to apply the term 'scientific' to one *single* theory is a category mistake. (1978: 34)

Looking at the issue in a diachronic manner, rather than focusing on a single theory, we can deem a research programme scientific only when it contains at least one theoretical stage that has some novel and testable consequence not contained in a previous stage, and that consequence passes testing.

If we put forward a theory to resolve a contradiction between a previous theory and a counterexample in such a way that the new theory, instead of offering a content-increasing (scientific) *explanation*, only offers a content-decreasing (linguistic) *reinterpretation*, the contradiction is resolved in a merely semantical, unscientific way. *A given fact is explained scientifically only if a new fact is also explained with it.* (1978: 34, emphasis as original)

This seems like it should provide a perfectly reasonable criterion for the rejection of the supernatural (and specifically creationism) from science, at least as far as current scientific opinion is concerned. Unlike Popper's falsification criteria, Lakatos' account is not troubled by the fact that creationism or any other supernatural doctrine is capable of making testable claims. What is significant is not that the claims are testable, but that the claims have not produced novel, confirmed results.

Creationism is unscientific because it only offers a reinterpretation of currently known content, rather than offer predictive success of its own.

While it might be the case that no supernatural research programme has met Lakatos' criteria, it is not clear that this lack of confirmed novel predictions should tell us anything about whether or not supernatural claims are investigable *in principle*. If we understand the supernatural solely as the kind of non-repeatable instances described by Schaferman, or accept Pennock's scepticism that anything can logically follow from a supernatural hypothesis, then of course no novel predictive success is possible. In *The God Delusion*, Dawkins somewhat derisively describes a double-blind experiment in which one group of hospital patients were prayed for and another group were not (2006a: 61-64). The experiment demonstrated no difference between the two groups, a fact which neither Dawkins nor theologians found to be particularly compelling evidence for anything.

What is interesting about the hospital patient example though, is that it raises the question: 'What if the results had shown that patients who were prayed for *did* get better faster?' It would seem that if this were the case, then Lakatos' sophisticated falsification criterion would have been fulfilled, and thus a supernatural phenomenon would seem to be entirely acceptable as part of a scientific research programme. As I have tried to make clear however, we cannot deem a phenomenon uninvestigable solely on the presupposition that it will be found to be false. That nobody was surprised that the patients were unaffected by prayer speaks only to the attitudes of those involved, and has no bearing on the content of the hypothesis itself. Similarly, while the unrepeatable nature of "A miraculous healing occurred" might render it impossible to accommodate within a scientific research programme, the claim that "Prayers result in faster healing" suffers from no such difficulty. That the latter is no less obviously a supernatural claim than the former illustrates that the separationist position misses the mark.

The current lack of evidential support for supernatural claims makes them unscientific in the sense that they are not part of established theory, but this lack of

support does not however exclude them from being, in principle, investigated by science. Lakatos' account thus offers us an interesting, and valuable, approach to the demarcation debate, whilst at the same time giving us no reason to accept the separationist position. We do not need to accept creationism as scientific, because it has not offered any novel predictive success, but this does not give us reason to blind ourselves and science to the possibility of investigating an entire ontological category.

Feyerabend and proliferation

Feyerabend famously said of science that "there is only *one* principle that can be defended under *all* circumstances and in *all* stages of human development. It is the principle: *anything goes*" (1975: 28). However, while he is often taken to be defending this principle, he does not actually endorse it. Rather, he argues that if one is to adopt the notion that there is some general and fixed principle that is true of all scientific method, then this is the only one that survives critique. Feyerabend is in fact criticising such an approach, arguing that the only thing that survives evaluation "will be empty, useless and pretty ridiculous – but it will be a 'principle'. It will be the 'principle', 'anything goes'." (1978: 188).

With that in mind, Feyerabend does offer some insights into ways that we might speak meaningfully about scientific method. Firstly, he places an emphasis on the values of certain goals or principles within science, and suggests that it can be meaningfully asked how best we might realise those goals. Of note, he endorsed the "principle of proliferation", which he suggests aims to achieve "maximum testability of our knowledge" (Nola and Sankey, 2007: 301). The methodological rule which he suggests follows from this goal is to: "Invent, and elaborate theories which are inconsistent with the accepted point of view, even if the latter should happen to be highly confirmed and generally accepted." (Feyerabend, 1981: 105). Pursuant to

this, and more pertinent to the discussion of demarcation, Feyerabend argues that it is possible to differentiate between "the crank" and "the respectable thinker":

The crank usually is content with defending the point of view in its original, undeveloped and metaphysical form, and he is not at all prepared to test its usefulness in all those cases which seem to favor the opponent, or even admit that there exists a problem. It is this further investigation [...] which distinguishes the "respectable thinker" from the crank. The original content of his theory does not. (Feyerabend, 1981: 199)

Pennock argues that here Feyerabend offers a scathing criticism of creationism:

It is almost as though he meant to apply this criterion to rule out creationism as crank science. Creationists of all stripes are well known as beginning with beliefs, both metaphysical and empirical, that they hold immune from empirical test. Feyerabend only fails to see that this problem is not just a matter of attitude – metaphysical immunity to test can indeed be built into the original content of the theory. (Pennock, 2009: 560)

Contrary to this I would argue that, when taken cumulatively, Feyerabend's analysis represents a stringent *defence* of creationism as science, or rather, a stringent defence of creationism *in principle* as science, and an even more stringent rejection of the separationist position. Firstly, by rejecting the notion that any general and fixed principle applies to all scientific methodology at all times, Feyerabend implicitly rules out the possibility of a fixed and general principle that "science cannot investigate supernatural phenomena". Secondly, by endorsing proliferation of theories, even those which are inconsistent with those which are "highly confirmed and generally accepted", Feyerabend offers an almost specific defence of any theory which opposes evolution. These two principles combined give us good reason to think that creationism is not only possibly a scientific endeavour, but an outright endorsable one.

Of course, I would not disagree with Pennock's analysis of creationism to date as displaying much of what Feyerabend condemns to "crank" methodology. However, this returns us to our discussion in chapter two regarding tentativeness and integrity in science. It is not a criticism of *creationism* that it has been practiced by crank

methods, but rather a criticism²³ of *creationists*. It is arguable, and indeed defensible, that being so closely linked to religious dogma does render creationism with "metaphysical immunity to test [...] built into the original content of the theory", as evidenced by the complete lack of reaction to the experiment referenced by Dawkins in the previous section. However there seems little, even on a theistic outlook, to suggest that one can *only* approach the theory with such immunity in place. That certain religious positions are held 'on faith', not just in the absence of evidence but *in spite of* it, does not entail that all supernaturalist claims must be approached in such a manner. Extricating the 'religiosity' from the theory however is a discussion we will need to return to in chapter seven.

Hoyningen-Huene and systematicity

Hoyningen-Huene rejects Feyerabend's scepticism regarding a distinguishing characteristic of science, as well as the earlier implications that all scientific endeavours feature some necessary or sufficient criteria of method which unites them. He instead identifies four historical "phases" of thought regarding the nature of science (2008: 167-168). The first, extending between the time of Plato and Aristotle and the 17th century, defined by attributing certainty to that which is scientific. The second, extending between the 17th and 19th centuries, which continued the focus on certainty but with the addition of what we would in modernity refer to as something like 'the scientific method'. The third, covering most of the 20th century, and characterised by our earlier discussion of Popper, Lakatos and Kuhn, acknowledges the fallibility of science, but also suggests that it can still be ascribed special status "due to its distinctive mode of production" (2008: 168).

²³ I use the term 'criticism' here to denote a criticism in the context of the creationist pretension to science. In other contexts, as we shall discuss in chapter seven, the adherence to religious belief in the face of contradicting evidence is not something which is universally considered a negative behaviour.

The fourth, and present, stage is represented by Feyerabend, and a scepticism of the existence of any defining scientific method or criteria for science: "At present, we are in the fourth phase, which started around the last third of the 20th century. In this phase, belief in the existence of scientific methods of the said kind has eroded. Historical and philosophical studies have made it highly plausible that scientific methods with the characteristics as posited in the second and third phase do not exist." (2007: 168). This is also the approach to science which I have tentatively endorsed throughout this discussion. It is fitting then, to conclude our analysis of scientific method with an approach which hopes to move forward.

Hoyningen-Huene suggests that rather than identify some unifying characteristic of scientific theory or method, we might instead argue that what unites scientific knowledge is that they share a family resemblance in increasing what he calls "systematicity": "Scientific knowledge differs from other kinds of knowledge, especially from everyday knowledge, by its higher degree of systematicity" (2007: 169). Hoyningen-Huene acknowledges that the term is vague and, rather than attempt to lay out a concrete definition, he offers examples for each of the eight "dimensions" in which he claims science to be more systematic than other enterprises. Though there is not room here to attempt a similar explication, some of the examples he offers include the use of systems of axioms, taxonomy, increased unification and predictive power, and attempts to eliminate errors (2008: 171-178).

What is striking about Hoyningen-Huene's approach is that it offers far more scope for nuance and accommodation than earlier approaches. Note that in his initial definition he describes science as having a "higher degree of systematicity", rather than as featuring systematicity simpliciter. He acknowledges that other activities, including many day to day activities, involve some degree of systematicity, and even that some exhibit more systematicity when approaching topics not covered by what we would commonly consider 'the sciences': "knowledge gained by police forces in suspected serial criminal cases is much more systematic than knowledge in loosely structured scientific fields" (2008: 169). Moreover, because he does not require an enterprise to increase systematicity in all of the eight dimensions he identifies, there

is no issue of unduly eliminating an activity as science that we have encountered in conceptions relying on strict necessary and sufficient criteria. For example, for Hoyningen-Huene not all sciences make predictions, let alone novel ones, or ones that are open to falsification.

Despite the inclusivity of the approach, Hoyningen-Huene does argue that there is scope to discuss demarcation meaningfully: "the dynamics of a scientific field can, in the most abstract way, plausibly be characterized by the tendency to increase its degree of systematicity, in whatever dimension it is possible [...]. The dynamics of typical pseudo-scientific areas, however, looks very different." (2008: 179). His approach is interesting for us because it not only allows us to see why creationism has not historically been considered science, but also see a way forward that it could become one. As Hoyningen-Huene outlines one distinction:

[T]here is typically no autonomous development of self-critical tests of the basic assumptions of the field. For instance, in many fields that are predominantly seen as pseudo-scientific, statistical approaches could be developed in order to test basic assumptions. But usually this is not done; if it happens at all, then it is typically done by outside scientists who try to challenge the respective field. (2008: 180)

This criticism echoes much of that from both Ruse and Pennock towards the Intelligent Design movement, but makes no reference whatsoever to the content of that being tested. Indeed, the implication of Hoyningen-Huene's final sentence here is that 'legitimate' scientists have been able to perform scientific approaches to such content. If creationism, creation science, or Intelligent Design are unscientific, then it is because the researchers in question have not approached the topics in question with a tendency to increasing systematicity, not because they happen to contain elements that might be considered 'supernatural'.

One might, as we have seen throughout our discussion, suggest that there is something special about the supernatural that renders it immune to increased systemisation. One of Hoyningen-Huene's other observations about pseudosciences is that they tend not to expand the knowledge applications, accuracy, or predictive

capacities of the field of study. If supernatural phenomena do lie outside of natural law, or outside of space and time altogether, then perhaps this is true.

As we have seen however, such conceptions of the supernatural seem untenable. While there may well be certain supernatural phenomena that are not amenable to such systematicity, as we shall discuss in the following chapters, this does not seem plausibly the case in general. Indeed, again, the only way that we could establish that all supernatural phenomena were immune to such investigation would be to actually investigate them in the first place. This poses no problem for Hoyningen-Huene's account, as a *systematic* investigation into that which is not open to testing seems both entirely scientific, and even perhaps achievable. However, for the separationist who wants to rule some phenomenon outside of the scope of scientific investigation *a priori*, without first attempting a scientific approach to it, then circularity emerges once more.

I do not wish to endorse systematicity fully as a way to understand the nature of science, though I do find the account appealing. However, this approach helps to show that we do not need to embrace full blown scepticism of scientific method, or demarcation, in order to reject the separationist account. I have argued throughout this thesis that there is no criterion for either science or the supernatural that is both uncontroversial enough to be taken for granted in a scientific or even legal defence of separationism, and also indicates any degree of mutual incompatibility between the two domains. However, Hoyningen-Huene's account suggests a progressive approach to thinking about both science and demarcation that allows us to accept that we can meaningfully discuss "the nature of science" whilst at the same time see no reason to accept a separationist account.

Conclusion

As ever, this analysis cannot be thought to exhaustively reflect the sheer breadth of discussion of demarcation with regard to scientific method. I have outlined a loose historical overview of the key points forwarded regarding the topic over the last century, which can be taken as informative of the broad state of the debate. However, once more, that there may exist some more esoteric account of scientific method which succeeds in furthering the separationist position is something which is worth considering, but not something which can be reasonably taken as justification for the adoption of that position in present scientific, legal or cultural circles.

We have seen that none of the primary approaches to scientific method, including even those which reject the concept, support the notion that scientific method in some way prohibits investigation of the supernatural. That said, we have also seen that many such approaches do suggest that creationism *in its current form* is not legitimate science. This result is not surprising, and should serve as reasonable comfort to those who would hope to exclude creationism from science classrooms. Importantly however, it is not something that hinges on the notion that creationism is either supernaturalistic or on the presumption that it is false. That creationism has not been presented in falsifiable terms, that it is not part of the current scientific paradigm, that it has not produced novel predictions, or that it has not been approached in a way that increases systematicity does nothing to suggest that the claims of creationists are not true, and certainly nothing to suggest that supernaturalist positions at large should be excluded from the domain of science. Rather these considerations illustrate that creationism is, according to commonly presented demarcation criteria, unscientific in its current form.

If there is a scientific method, then while we can plausibly state that thus far creationism has not been successfully defended in accordance with it, we have no need to adopt a principle of separationism regarding science and the supernatural in order to determine that this is the case. The separationist position is not only untenable, but it is also unnecessary in defending the commonly held belief that

enterprises such as creationism are not science. Creationism has failed every criterion for demarcation presented throughout our discussion, and would have done so equally were the posited designer natural in origin. The separationist position then is not simply an excessive and unjustified approach to deeming creationism unscientific, but it is also one that is completely unnecessary.

Chapter 6

The supernatural as that which is outside of space and time

The final potential understanding of the supernatural that we shall address in detail is the notion that it is that which is 'outside' of the natural world. Though there are numerous ways in which we might interpret this, the simplest locus for discussion on this point rests with theism. Not only does the theistic God represent a widely acknowledged example of this conception, but it is also the area in which the most contentious debates around this subject occur, as is illustrated in our discussions of the creationist movement.

While the theistic arguments for creationism are perhaps the ones most commonly discussed in relation to science, this is largely due to the cultural factors surrounding the movement that we saw in chapter one. Recalling Hansson (2008), an enterprise is often only regarded as pseudoscientific if its "major proponents try to create the impression that it is scientific". However creationism, and design arguments in general, are merely one facet of the diverse landscape of natural theology. That proponents of other such positions have not been engaged in the same battle to be recognised as scientific should not exclude them from consideration. In this chapter then we shall examine not only arguments from design, but several other lines of reasoning which attempt to link empirical observation to the conclusion that God does (or does not) exist.

Before addressing any specific argument we will take some time to address loosely what it means for an entity to exist 'outside' of space and time or, as this issue is blurry, for it to exist non-physically and atemporally. It will be impossible to address this issue in any kind of depth, as a discussion on the exact nature and boundaries of space, time, and the natural world is a subject far beyond the scope of this thesis. I contend, however, that a broad understanding will suffice in the context of this debate. As ever, if the separationist position hinges on any particular esoteric

ontology or metaphysics, then the separationist has a great deal of work to do prior to advocating exclusion of the supernatural from the mainstream scientific enterprise.

Moving on to the arguments themselves, we shall begin by examining the *kalam* cosmological argument. This serves as one of the clearest examples of an attempt to infer from empirical observation of the world around us to a conclusion that concerns things which are of necessity not within it. I argue that regardless of its soundness, or even validity, the *kalam* offers an insight into the ways that we might well begin to make such inferences. Following on from this, I return to the ever-present issue of design. This time, we shall take our discussion back beyond the creationist movement as we have thus far encountered it, and discuss the interactions of William Paley and David Hume to show that both proponents and detractors of such inferences can appeal to an at least tentatively scientific methodology.

In order to reinforce the claim that we might consider design inferences to be scientific, or at least to undermine the idea that such a consideration does not rest on traditional conceptions of 'supernaturality', I shall then draw a comparison between traditional design inferences and modern multiverse theories. This is not to assume that design inferences are on the same footing as multiverse hypotheses in terms of scientific credibility, but instead to show that the principles involved in determining whether or not something is scientifically investigable are not obviously drawn along the lines argued by the separationist. In relation to this, I will then discuss the arguments from the apparent 'fine-tuning' of the universe, and the potential for abductive reasoning as a scientific step from empirical observation to either a theistic or a multiverse hypothesis.

Turning away from arguments in favour of the existence of God, we shall turn instead to arguments *against* the existence of such an entity, in particular via the problem of evil. This serves three useful purposes in our discussion. Firstly, it offers a further example of inferences regarding that which is beyond the limits of space

and time which are based on empirical observation. Secondly, it further legitimises the theoretical scientific nature of the preceding arguments by offering them potential falsification criteria. Finally, it reinforces the normative claim made in chapter one that separationism is of benefit to neither the supernaturalist nor the anti-supernaturalist.

Finally, I shall introduce two arguments which point towards the idea that, far from methodological naturalism being a useful tool within science, instead science must *assume* supernaturalism in order to function. Roughly speaking, this is the suggestion that in order to accept that the laws of nature operate in a predictable fashion, and that our cognitive faculties are reliable enough to apprehend them, we must assume a supernatural basis for both. Although I do not defend these arguments, I suggest that the separationist position is of necessity non-neutral in regards to them. Thus, the purported motivating principles behind separationism have no purchase when it comes to defending methodological naturalism.

'Outside' of space and time

As we have seen, attempts to delineate between the natural and the supernatural have a tendency to appear circular, which will necessitate the use of a broad brush in discussing this topic. Draper outlines the distinction in the following terms:

"[N]aturalism" is the hypothesis that the natural world is a closed system, which means that nothing that is not a part of the natural world affects it. Naturalism is logically incompatible with theism because theism implies that the natural world was created (and so affected) by a supernatural entity (namely, God), while naturalism implies that there are no supernatural entities, or at least none that actually exercises its power to affect the natural world. By the "natural world," I mean the collection of all existing physical entities (past, present, and future) together with any entities whose existence depends (either causally or ontologically) on the existence of those entities. "Natural" entities are entities that are part of the natural world so defined, and a "supernatural" entity, if there is such a thing, is simply an entity that can affect the natural world despite not being a part of it. (2007)

Avoiding circularity then, we can unpack several details as to what it is that Draper means when he refers to something not being part of the natural world. Namely, anything that is not a physical entity that exists in the past, present or future, nor that is a non-physical entity that is dependent upon such things for its existence. Additionally, he references God as an entity that he explicitly considers to be supernatural.

These criteria allow us to think loosely of the supernatural in similar terms to those outlined in Plantinga's discussion of the universe as a "closed system" (2011: 78). Whatever the exact boundary between the supernatural and the natural, we can consider the boundaries of space (where any physical entity must exist) and time (past, present and future) to serve as an imperfect guide. This thinking is also reflected in Armstrong's approach: "Naturalism I define as the doctrine that reality consists of nothing but a single all-embracing spatio-temporal system" (1978: 261).

It should be noted that this delineation is not obviously in keeping with common usage of the terms, rendering vampires, unicorns and goblins squarely within the natural realm, and perhaps even extending this appellation to ghosts, extra-sensory perception and astrological effects. However, as Clarke argues:

We may be unsure whether ghosts and goblins are best understood as supernatural entities or as unusual natural entities. However, on any understanding of the natural-supernatural distinction that shows at least some respect for ordinary usage, God – an all-powerful agent whose existence is unconstrained by either space or time – will be understood as a supernatural agent and ordinary worldly entities – tables, chairs, and the like – will be understood as natural entities. (2009: 130)

Although I consider this somewhat fuzzy approach to the natural/supernatural distinction deeply problematic, and will return to this issue in the following chapter, it will serve us well enough to accept it for the present purposes. It also allows us to dedicate our attention in this chapter specifically to the weaker form of separationism, as well as to focus on supernatural hypotheses as opposed to observed supernatural phenomena. That sensible employment of the term supernatural might render ghosts and goblins "unusual natural entities" seems at

least problematic enough to draw into question exactly what the separationist is claiming should be excluded from science, and certainly problematic enough for us to be wary of employing the term in scientific or legal policy. However, in the interest of examining as many possible interpretations of the separationist claim as we can, we shall grant this limited usage here. If even this level of separationism is ultimately unviable, then the separationist has no further concession available to make.

The kalam cosmological argument

In order to examine the concept of the supernatural as that which exists beyond space and time we shall begin by addressing the *kalam* cosmological argument. This argument is especially relevant here for several reasons: firstly, it has a unique focus on this particular boundary; secondly, unlike other arguments from natural theology which we shall discuss later, the argument does not obviously invoke 'violations' of the laws of nature in a way that might otherwise render it unscientific by Ruse's criteria²⁴; and finally, the *kalam*'s most prolific recent defender, William Lane Craig, has frequently appealed to scientific evidence in order to support its second premise.

In its simplest form, the *kalam* argument is as follows:

Everything that begins to exist has a cause.
The universe began to exist.
Therefore, the universe has a cause. (Craig and Sinclair, 2009: 102)

Interestingly, in light of the definition of the supernatural we are currently considering, then if this argument is sound, it need not take us to God in order for it to establish the existence of the supernatural. So long as the universe is not self-

²⁴ Though the argument does infer the creation of matter and energy *ex nihilo* which would violate the first law of thermodynamics, discussions of violations of the laws of nature can plausibly only be deemed sensible upon the actual existence of nature itself.

caused, or else caused by one of its physical components or anything dependent upon them for its existence, then whatever the cause of the universe is, that cause will be supernatural. Although I would not be quick to dismiss either of these options given the assumption that the universe has a cause, for the sake of analysing the relationship between the *kalam* and science, let us ignore these possibilities, and therefore grant that it leads to a necessarily supernatural conclusion.

How then, does the *kalam* relate to science? Well, Craig argues that the second premise of the argument is supported, in part²⁵, scientifically. He argues that:

According to current cosmological theory, time and space came into existence with the Big Bang [...]. On such an understanding, the universe did not spring into being at a point in a previously existing empty space. Rather space and time themselves come into being along with the universe, which implies creation out of absolutely nothing. (2001: 256)

Additionally, after examining various scientific theories as to the nature of the Big Bang, Craig concludes that:

Our survey shows that contemporary cosmology is quite supportive of the second premise of the *kalam* cosmological argument. Further, this conclusion is not reached through ferreting out elaborate and unique failure conditions for scores of individual models [...]. It seems that the field of cosmology, therefore, yields good evidence that the universe began to exist. (Craig and Sinclair, 2009: 181-182)

Although Craig goes on to argue that the cause of the universe must possess the attributes commonly ascribed to the Christian God, this is, as we have said, an unnecessary extension for our purposes. So long as the cause of the universe is not the universe itself, one of its physical components, nor anything dependent on one of its physical components, then by our current definition the *kalam* argument, if successful, establishes the existence of a supernatural entity.

²⁵ Although Craig argues that there are philosophical reasons to accept this premise, primarily the impossibility of an actual infinite (see Craig and Sinclair, 2009: 103-125) this does not affect our discussion. We can assume, for sake of argument, that no such philosophical support exists.

One might object that Craig here has not offered scientific support for the conclusion of his argument, but rather for one of the premises. It is thus not the case that science has investigated supernatural phenomena, but rather natural phenomena, whilst philosophy has done the legwork required to arrive at a supernatural conclusion. As no one is objecting to the notion that the supernatural fall within the remit of philosophy, this seems to present no apparent problem for the separationist.

This objection, while technically plausible, does somewhat miss the point however. While the argument itself is philosophical in nature, it is not difficult to imagine a situation whereby premise two ("The universe began to exist") were presented not as a stepping stone in an argument, but rather as a testable prediction of a supernatural hypothesis. Say that, prior to the origin of the Big Bang theory, someone had posited that the universe had a cause, and that as a result of this they predicted that it had a beginning. This would have constituted a testable scientific hypothesis (to whatever degree it is accepted that the Big Bang constitutes both a beginning for the universe and a testable scientific hypothesis). Indeed, given the *kalam*'s origins in early Christian and Islamic scholarship, one might even reconstruct such a notion historically as a "novel consequence" of such a hypothesis.

Alternatively, one might argue that while the second premise of the *kalam* is testable, the conclusion it draws is not. However, as well as facing the difficulties already outlined regarding falsification, this criticism cannot actually follow. The argument is, at least in principle²⁶, a logically valid, deductive argument. Given this, if the premises are true, then the conclusion must also be true by the rules of deductive logic. So long as one accepts the truth of the first premise then any efforts to investigate the second premise scientifically are, by extension, efforts to investigate the conclusion scientifically. If we grant scientific investigability to the second premise, then we grant implicit scientific investigability to the conclusion.

²⁶ Draper, for example, has argued that the *Kalam* equivocates over the term "begins to exist", and would thus be invalid (1997: 172-177).

This response does, of course, open the discussion up to a further response: that scientists are not obliged to think that the first premise is true. Thus, again, whilst one may test the second premise, this potential disconnect between its truth and that of the conclusion renders the conclusion squarely in the realm of philosophy, rather than science. This analysis is compounded by the fact that, as Craig himself describes it, the first premise is "rooted in the metaphysical intuition that something cannot come into being from nothing" (Craig and Sinclair, 2009: 182). It is surely reasonable to argue that if anything moves a claim out of the domain of science, then depending on a metaphysical intuition stands as a reasonable candidate.

Without getting drawn into a discussion on the dividing line between philosophy and science, we can however note several responses to such a critique. Firstly, although Craig acknowledges the foundation of the first premise as metaphysical, he also argues that it "is constantly confirmed in our experience. Scientific naturalists thus have the strongest of motivations to accept it." (2009: 187). While I make no commentary on the validity of this claim, it is at least hypothetically possible that the first premise of the *kalam* enjoys the same kind of scientific investigability as the second, thus eliminating any necessary metaphysical leap towards its conclusion.

Secondly, it is at least plausible that science operates under such metaphysical assumptions. We have seen that separationists will gladly accept the notion that science operates under the assumption that metaphysical naturalism is true, even if only for methodological purposes. The first premise of the *kalam*, related as it is to the Principle of Sufficient Reason and *ex nihilo nihil fit*, is arguably as defensible an inclusion into scientific methodology. Let us look at how Draper argues in defence of a modest methodological naturalism:

A strong presumption of naturalism based on everyday experience and the success of naturalistic science justifies a modest methodological naturalism: the reason scientists should not look for supernatural causes is that natural causes are much more likely to be found. A methodological naturalism justified in this way is "modest" because it implies that scientists should look *first* for naturalistic explanations, and (depending on how strong the presumption of naturalism is) maybe second, third, and fourth too, but it does not absolutely rule out appeals to the supernatural. (2005: 297)

This argument makes two important claims with relation to our examination. By arguing that as a methodological principle science should first look for natural causes, then supernatural ones, it makes the implicit assumption that it is part of the methodology of science to look for causes at all. Indeed, it suggests that supernatural causes should be considered *before* assuming that no cause exists. Even allowing for the metaphysical possibility of acausal events or entities, it seems sensible to suppose that science operates on the methodological assumption that any given phenomenon does have a cause or explanation. Either way, at least on Draper's summary, methodological naturalism is to be abandoned as an assumption *before* abandoning a methodological commitment to the first premise of the *kalam*.

More compellingly, given our current understanding of the supernatural as that which exists beyond space and time, we are forced to bypass the first, second, third, and fourth attempts to find a naturalistic cause of the universe. Whatever the cause of the universe is, assuming that it has one or that one should be searched for, that cause *must* be supernatural according to Draper's own definition (or else caused by itself or one of its own constituent parts). Thus, even accepting a modest form of methodological naturalism, we are justified in positing a supernatural hypothesis in this specific case if the *kalam* is sound.

Finally, and perhaps most pressingly to our discussion, none of these considerations regarding the premises of the *kalam* rely on the supernaturality of the thing being investigated. Even granting that "Everything that begins to exist has a cause" is a metaphysical principle, the *kalam* would be equally valid if one replaced "the universe" in each of its instances with "this table" or "the current President of the United States". Whether or not it is a matter of scientific enquiry is not determined by the nature of the cause being posited, but rather by the nature of the argument and one's particular views on the relationship between science and philosophy.

The nature of the cause and a return to design

One could argue that while the *kalam* might point us towards some cause that is external to the natural world, it cannot tell us anything about that cause which is scientifically testable. Thus, to return again to weak separationism, while the second premise of the argument is open to scientific investigation, the content of the conclusion is not. Rather than allowing us to investigate the supernatural scientifically, all the *kalam* does is to point to the idea that were it within the scope of scientific investigation, then scientific methodology would compel us to search for a cause of the universe.

Here then we return, as ever, to the subject of Intelligent Design. While the *kalam* argument, even in its extended versions, may not give us scope to scientifically investigate the cause itself, arguments from design do claim to make such inferences. Where the *kalam* only 'predicts' a beginning to the universe, which gives us little to go on with regard to the nature of the cause that led to it²⁷, design arguments rely on the notion that the cause of certain elements of the universe is, at minimum, intelligent, creative, and has purpose.

Like the *kalam*, design arguments long predate contemporary discussions of demarcation and Intelligent Design. Writing in the New York Times, Behe explicitly draws a link between the modern Intelligent Design movement, and the classic "watchmaker" argument forwarded by Paley:

[T]he physical marks of design are visible in aspects of biology. This is uncontroversial, too. The 18th-century clergyman William Paley likened living things to a watch, arguing that the workings of both point to intelligent design. Modern Darwinists disagree with Paley that the perceived design is real, but they do agree that life overwhelms us with the appearance of design. (2005)

²⁷ Craig has argued that we can infer several details regarding the nature of the cause of the universe, including that it is uncaused, beginningless, changeless, immaterial, timeless, spaceless, enormously powerful, and personal (Craig and Sinclair, 2009: 191-194). However, though one might pursue a defence of the scientific nature of these inferences, they wander further into the realm of philosophy than is prudent to address here.

Paley's argument is perhaps the best known and most oft quoted formulation of a design argument. As he outlines it in the opening chapters of his *Natural Theology*:

In crossing a heath, suppose I pitched my foot against a *stone*, and were asked how the stone came to be there; I might possibly answer, that, for anything I knew to the contrary, it has lain there forever: nor would it perhaps be very easy to show the absurdity of this answer. But suppose I had found a *watch* upon the ground, and it should be inquired how the watch happened to be in that place; I should hardly think of the answer which I had before given, that, for anything I knew, the watch might always have been there. (1802: 5)

He argues that the reason for this discrepancy is that the several parts of the watch are organised with a clear *purpose*. That were they arranged differently, or were they a different shape or size, they would not result in the function that they are seen to produce. This, he claims, is clear evidence of an artificer (or artificers) who has created the watch for this end. He continues:

This is atheism: for every indication of contrivance, every manifestation of design, which existed in the watch, exists in the works of nature; with the difference, on the side of nature, of being greater and more, and that in a degree which exceeds all computation. (1802: 13)

The spirit of Paley's argument is clearly seen in the modern Intelligent Design movement. Paley's appeal to the fact that rearranging or changing the individual parts of the watch would negate its function are strongly echoed in Behe's own arguments regarding "irreducible complexity".

Although the responses we have focused on in this discussion have centred on the notion that arguments such as Paley's and Behe's are unscientific, there have been many responses from the realm of philosophy to the effect that they are simply invalid. Most famously, those presented by Hume's character Philo in his *Dialogues Concerning Natural Religion* which, though published twenty-three years before Paley's work, discusses many of the points it raises.

There is not space here to go into a great amount of detail, nor list every argument that Hume forwards. Some prominent examples focus on either the inconsistency between the attributes of the designer that would be inferred and that described in

Christian theology ([1779] 1993: 51), or else on the need for an explanation for the designer, and the regress that would follow ([1779] 1993: 62), none of which is of concern to our discussion. Whether the extra-universal entity we can infer is similar to the Christian God, or if it requires an explanation, does not affect that such an entity can be inferred, and we can say things about it that might contradict any picture at all.

Of more interest to us are Hume's arguments concerning the strength of the analogy. So Philo claims, the analogy to the watch is too weak, that the dissimilarity between the universe and the products of human artifice "is so striking, that the utmost you can here pretend to is a guess, a conjecture, a presumption concerning a similar cause" (1779: 46). Moreover, that:

All the new discoveries in astronomy, which prove the immense grandeur and magnificence of the works of nature, are so many arguments for a Deity, according to the true system of theism: But according to [...] experimental theism, they become so many objections, by removing the effect still further from all resemblance to the effects of human art and contrivance. (1779: 67)

What is noteworthy here, regardless of the success of Paley's argument, or Hume's critique, is that both can be adapted to fit the criteria set out by Ruse and Overton. Assuming that at least some concrete design criteria are set out, perhaps some extension of Paley's claim that "we deduce design from relation, aptitude, and correspondence of parts" (1802: 213), then Paley affords us with a claim that is testable. Namely, it suggests that the universe possesses certain qualities which, upon investigation, we will discover. As we discussed earlier, that some proponents of Intelligent Design have been reluctant to present such criteria, or that the universality of the claim renders it unfalsifiable, does not render the claim itself untestable in principle. Moreover, by restricting the claim, perhaps by limiting the prediction to a specific feature of the universe (as we shall discuss below regarding fine-tuning arguments) we can render it, if not falsifiable in a strict sense, at least open to failed prediction.

Similarly, Hume's claim that the universe possesses no, or at least very few, attributes with which we associate design, is equally testable. Hume does not reject the design inference on the grounds that the inference is beyond scientific enquiry (indeed, Hume refers to the endeavour as "experimental theism"), but rather because the evidence does not support the proposed conclusion.

We see then that of Ruse and Overton's criteria for science, the third ("It is testable against the empirical world") and fifth ("It is falsifiable") can be accommodated even by traditional design inferences. As discussed in previous chapters, tentativeness of conclusion is not something which need concern us. Regardless of the disposition of Paley, Hume, Intelligent Design theorists, or anyone else, it is possible for *someone* to investigate the design hypothesis tentatively. The argument itself, let alone any supernaturalism it entails, is irrelevant to this. Thus we can discount the fourth criterion ("Its conclusions are tentative") as problematic as well.

This leaves us with the two most problematic criteria: "It is guided by natural law" and "It has to be explanatory by reference to natural law". The latter of these is, surprisingly, largely in tune with Paley's argument, and with design inferences in general. While we might be hesitant to attribute the term "natural law" to such a situation, the notion that all instances of a specific kind of relation, aptitude, and correspondence of parts are the product of design fits exactly the kind of schema for natural laws that we have examined. Paley is not suggesting the kind of unpredictable or violating event against which this criterion is intended to ward, but rather works towards establishing the kind of regularity it is intended to emphasise. This is not of course to say that Paley is describing something which we could comfortably describe as a "natural law", but rather that the underlying motivations for insisting that science adheres to such laws (for example for the purposes of falsifiability and prediction) are not contravened by this approach.

A more difficult issue is that of being guided by natural law. Given the definition of supernatural on which we are currently focusing, then even allowing for Plantinga's solution to the idea that interactions by a deity would 'violate' natural law by

distinguishing between closed and open systems, we are still left with the issue that even if they are not in violation of such laws, acts by an entity external to the universe seem difficult to consider guided by them.

There are several ways that we might attempt to deal with this issue. Most obviously, we can reject the criterion. In a discussion regarding the legitimacy of supernatural investigation within science, such a criterion is overtly question begging, though of course so would be a rejection of it. Alternatively, we could refer to our earlier discussion of the difficulty in coherently outlining a 'violation' of a natural law, and extend this reasoning to say that we cannot confidently understand what it would mean for something not to be "guided by natural law" either. Unfortunately, in this current context, we have a very clear (at least, in principle) idea of what it means to have violated, or at least interfered with, natural law. An entity that is by definition outside of the natural world and is acting upon it is, even if this is unproblematic in all other respects, at least superficially in opposition to this criterion. That being said, I would suggest that there are at least two lines of argument that we can employ to show that this criterion is inappropriate even in this context.

The first argument I would present is that whilst the dividing line between the spatiotemporal world and the supernatural is seemingly sensible, being located at the 'edge' of the universe itself, it is arbitrary in terms of scientific investigation. Suppose, for a moment, that Paley's criteria may be formulated into a truly testable hypothesis. Now, pursuant to this, suppose that some feature of what we consider the natural world was in fact designed by an intelligent race of aliens. For the sake of familiarity, let us say the human eye. Paley, suspecting this, points to that feature and argues that, if it is designed, then it will exhibit features X, Y and Z. Then, upon investigation, we discover that it does indeed exhibit such features. This hypothesis would, due to the fact that the intelligent alien race is not extra-universal, seem to satisfy the criteria outlined as necessary for being science. Assuming, of course, that investigations into the acts of intelligent beings such as those pursued by forensic and social scientists qualify as 'science'.

Of course, one can argue that such a hypothesis is not really tenable. For one, because the theory of evolution offers a more parsimonious explanation for the perceived data, and for two because any potential designer for such a feature would have to possess features X, Y and Z *as well*, and thus the inference simply leads us to infinite regress. However, for our purposes this does not actually matter. The viability of the hypothesis is not what is in question, but rather whether or not supernatural factors into whether or not it is investigable by science.

It seems to me that supernaturalism does not factor in such a way. If such an inference could work for an alien race, then there seems to be no obstacle posed by locating that race outside of the universe in terms of investigability. This is especially true if we also, perhaps by noting the infinite regress it would lead to, deduced that whatever the designer is, it *must* be located outside of the universe. Conversely, if we cannot make such an inference for an alien race, then externality to the universe is not the relevant factor in eliminating such a hypothesis.

We thus see no reason to think that the criteria of being guided by natural law, even in this extreme context of extra-universal deities, has any bearing on scientific investigability. In addition to this hypothetically framed defence, we can also put forward a second more grounded argument, though one that is perhaps more controversial, in the fact that many scientists are perfectly willing to discuss extra-universal phenomena. Specifically, they are willing to posit, and even test, the notion of a 'multiverse'.

Multiverse theory and testability

Discussion of a single multiverse theory, or even a single type of multiverse theory is misguided. Though not all distinctions will be relevant here, it is important to note that not all theories described as relating to a multiverse actually posit anything we

might consider 'extra-universal' in the currently intended sense of being outside of space and time.

The universes generated by eternal inflation have a common causal origin and share the same space-time, for which reason they do not form a completely disconnected multiverse. Nor is this the case for cyclic models of the Steinhardt-Turok type. The other universes are not accessible to observers located in our universe but are nonetheless connected, which distinguishes this kind of multiverse from ideas of a genuine multiverse made up of strictly disjoint universes such as proposed by Tegmark and others. (Kragh, 2009: 539)

There is a definite philosophical distinction to be drawn between theories which posit entities or processes that share space-time and those which do not, though the practical basis for this discussion does not necessarily hinge upon it. The universes in the former category may be just as causally disconnected from our own as those in the latter and, moreover, may feature just as distinct a set of 'physical' laws. This means that it is unclear not just whether or not multiverse theories in general may be considered scientific, but also which specific multiverse theories qualify and which do not.

With that in mind, conversations regarding the multiverse are quite illuminating. On the one hand many who have opposed the multiverse as scientific have done so on the grounds of testability. As Paul Davies neatly summarises the concern, whilst himself linking it to our point of current interest:

[H]ow is the existence of the other universes to be tested? To be sure, all cosmologists accept that there are some regions of the universe that lie beyond the reach of our telescopes, but somewhere on the slippery slope between that and the idea that there are an infinite number of universes, credibility reaches a limit. As one slips down that slope, more and more must be accepted on faith, and less and less is open to scientific verification. Extreme multiverse explanations are therefore reminiscent of theological discussions. Indeed, invoking an infinity of unseen universes to explain the unusual features of the one we do see is just as ad hoc as invoking an unseen Creator. The multiverse theory may be dressed up in scientific language, but in essence it requires the same leap of faith. (2003)

Conversely, Leonard Susskind has argued in defence of the scientific status of String Theory, and has been particularly vocally opposed to the kind of falsifiability criteria

laid out by philosophers. He argues: "As for rigid philosophical rules, it would be the height of stupidity to dismiss a possibility just because it breaks some philosopher's dictum about falsifiability. What if it happens to be the right answer?" (2006: 196). This point of view echoes the sentiments of Plantinga we discussed in chapter one regarding the exclusion of supernatural investigation, and much of the driving considerations of our discussion as a whole. It also captures the sentiment of others in cosmology:

Several of the proponents of the multiverse and anthropic reasoning suggest that physics is at a crossroads, on its way to shift from one paradigm to another – Kuhnian phrases occur abundantly in the literature. Perhaps 'we are facing a deep change of paradigm that revolutionizes our understanding of nature and opens new fields of possible scientific thought'. The Nobel laureate Steven Weinberg and others are ready to accept multiverse theories based on the anthropic principle as a new style of physics which in some areas replaces the computational-experimental style based on first principles. (Kragh, 2009: 543-544)

Such an abandonment of testability as a cornerstone of scientific method has not been without objection. Although much of this opposition has been on the grounds of commitment to falsifiability in science as a fundamental principle, in a somewhat telling argument from mathematician George Ellis, he draws the link directly to more traditional talk of excluding 'pseudosciences':

The very nature of the scientific enterprise is at stake in the multiverse debate. Its advocates propose weakening the nature of scientific proof in order to claim that the multiverse hypothesis provides a scientific explanation [...]. The Popperazi (a derogatory term used by Susskind for those who believe testing scientific theories is an indispensable aspect of science) will no longer be able to deny astrology its place as a proper scientific theory. Is that what we really want? (2008: 2.33-2.35)

Though I have by no means done justice to the complexities nor extent of the multiverse debate here, there are numerous interesting observations that we can take away from these brief insights. Firstly, that scientists are not universally committed to the kind of falsifiability that has been presented in opposition to Intelligent Design. Secondly, that being beyond the borders of our universe does not automatically constitute exclusion from the scientific enterprise. Thirdly, that the

spectre of pseudoscience looms over at least some of the reluctance to accept multiverse theory, and a revised approach to science.

Given these considerations, it seems that even the exclusion of arguments such as the *kalam* from science may require closer attention. As cosmology takes us further and further beyond the realm of empirical observation, attachments to simple notions of testability and falsification may need to fall by the wayside, or at least be adopted less stringently. Alex Orenstein notes:

The more sophisticated twentieth-century methodology places relatively less stress on the force of direct evidence than it does on that of indirect evidence. Science is not just a collection of sentences [...]. Rather, science is a web of logically inter-connected sentences [...]. [E]vidence, especially for the more theoretical parts of science, for example, ' $E=mc^2$ ' or molecular theory is not direct. Such evidence draws consequences from those theories. These consequences in turn eventually yield other more observable consequences that provide indirect tests for those theories. (2002: 86)

As ever, even if one objects to such an interpretation of scientific method, we once again see that supernaturalism is of little importance to the debate. If the *kalam* or Intelligent Design arguments do fail the criteria for science, then they do not do so on the basis of the supernatural nature of their conclusions, unless we wish to say the same thing of multiverse hypotheses, or perhaps any number of theories founded on indirect evidence.

One final point of interest which we can derive from these discussions is to note Helge Kragh's allusion to the link between multiverse theories and "anthropic reasoning" (2009: 543). Although I would avoid drawing a strong link between the two, this does neatly lead us to the third breed of natural theological argument that we shall consider: arguments from the fine-tuning of the universe.

Fine-tuning arguments

Speaking loosely, the anthropic principle dictates that the nature of the physical universe must, for it to be observed, be compatible with the existence of those which might observe it. The constants and laws which we discover in nature need to be such as to allow for intelligent life capable of discovering them, otherwise it would be impossible for us to have discovered them. Theoretical physicist Lee Smolin, calculating the probability that stars might exist given random parameters for the initial conditions of the universe, estimates a likelihood of such constants obtaining as being somewhere in the region of one in 10^{229} . As he states the case: "In my opinion, a probability this tiny is not something we can let go unexplained. Luck will certainly not do here; we need some rational explanation of how something this unlikely turned out to be the case." (1997: 45).

Supposing that Smolin is correct that such an occurrence does demand explanation, then there are a few avenues that we might pursue. Either, the parameters that we see are in some way *necessary*. As Smolin outlines the possibility, this "approach to explaining the parameters is the hypothesis that there is only a single unique mathematically consistent theory of the whole universe. If that theory were found, we would simply have no choice but to accept it as the explanation." (1999: 45). Of course, while this may be the case, it does not undermine the idea that the necessity of such constants does *seem* remarkably fortuitous.

The main alternatives we have already seen. If some form of multiverse theory is correct, and a sufficiently large number of universes either has, does or will exist (or exists in non-temporal relation to us), then the occurrence of a universe even with an unlikelihood exceeding Smolin's calculation will turn out to be unsurprising. Moreover, as the anthropic principle suggests, it is also unsurprising that this is the type of universe we in fact observe. It is worth noting however that we would misconstrue multiverse theory by presenting it as an exclusively *ad hoc* explanation for these coincidences:

A few of the multiverse theories proposed in the 1980s were motivated by attempts to explain various anthropic coincidences, but this was not generally the case. Not only are the two approaches, the one based on multiverse scenarios and the other on the anthropic principle, logically distinct from one another, they were rarely seen as connected until the last decade of the century. Indeed, inflation cosmology was often seen as an alternative to anthropic reasoning because it might seem to make anthropic explanations redundant. Only later did it become common to conceive inflation as a justification of the anthropic principle and at the same time a modification of it. (Kragh, 2009: 537)

Conversely, we might posit the idea that the apparent 'fine-tuning' of the universe is indicative of an intelligent designer who has arranged the parameters in such a way as to allow for intelligent life. As Plantinga reviews the argument, albeit hesitantly: "The basic idea is that such fine-tuning is not at all surprising or improbable on theism: God presumably would want there to be life, and indeed intelligent life with which (whom) to communicate and share love." (2011: 199).

The important question for us is not whether or not a design hypothesis might be successful, but rather whether it is sufficiently different from these other hypotheses in relevant ways so as to render it unscientific. There are two main ways that we might argue that this is the case, other than simply forbidding supernatural phenomena outright. Firstly, on the grounds that it is untestable and makes no predictions. Secondly, because it is too weak an argument.

While the first of these objections is indeed troubling, it is no more so than in the case of multiverse theory. We have seen a glimpse into the arguments surrounding that hypothesis, and they are certainly not something that can be easily dismissed. If one weighs against multiverse theories as a scientific enterprise, then one might be justified in also weighing against design inferences from fine-tuning. *However*, if one does not weigh against multiverses in such a way, and grants that the kind of abductive reasoning that anthropically motivated multiverse theories are indeed scientific, then one does not seem justified in excluding design hypotheses on such a basis.

On the other hand, we might simply argue that the design hypothesis is unscientific simply because it is too poorly supported by evidence. There are too numerous alternative, and arguably more parsimonious, explanations to warrant positing an entirely new ontological category of being as the best explanation. Moreover, even the weak methodological naturalism suggested by Draper would demand that we favoured multiverse hypotheses before considering something 'supernatural' as an explanation. Of course, given the definition we are currently examining, many flavours of multiverse theory *are* supernatural in nature, so the strength of such an argument is debatable.

While I think these considerations are reasonable, it is unfair to treat fine-tuning design hypotheses as isolated arguments. Even limiting ourselves to arguments from natural theology, and ignoring less controversially unscientific reasons to believe in divine creation such as divine revelation, then we have seen at least three separate lines of argument towards such a conclusion in this chapter alone. The God hypothesis need not be treated as the answer to a single question, but rather as the result of a cumulative set of inferences (What caused the universe? Why is there the appearance of design? Why does the universe seem fine-tuned to permit life?). Seen in this light, it stands defensibly in better stead than at least the anthropically motivated brands of multiverse theory, at least in this isolated context. If we do not limit ourselves in such a way, and allow for revelatory evidences to be considered so long as, say, they allow us to make novel predictions, then this strengthens the case even further.

Of course, while the discussion here I think grants us reason to question the unscientific nature of a God hypothesis *in principle*, I have spent no time evaluating the *strength* of these arguments. I make no case that natural theology is good science, only that it is not obviously *not* science. One of the key reasons to think that multiverse theory might be regarded as scientific is the fact that so many scientists take it seriously. It would require far more support and examination within the scientific community itself before design hypotheses might be thought of as anything more than potentially scientific. I do not reject the arguments seen in chapter two

that science is an inherently *communal* activity. What I argue here is that any inclusion or exclusion should be consistently organic rather than, as Susskind objected to as regards falsifiability, dictated by the whims of armchair philosophy.

Before moving on, it is worth noting that arguments such as those outlined above do not solely arise from the pro-supernaturalist camp. There have been many atheological arguments derived from observation of the world around us, most famously, and most prominently, of which are the various 'problems of evil'.

Natural atheology

It is worth mentioning that, to whatever degree the above arguments from natural theology are testable, they are also to some degree open to negation. This is not to say that they are falsifiable outright, but that research into their predictions can return negative results. While we cannot, for example, conclusively rule out the possibility that there exist features of design *somewhere* in the natural world we can, for any given investigation, fail to find such features. Pursuantly, it is at least conceivable that on investigating the so called 'fine-tuning' of the universe, we might have discovered that in actuality there were many ways in which the universe could be configured such that life was possible.

Alternatively, we might discover that there are very few configurations which support intelligent life, in line with the argument from fine-tuning. Of course, given the kind of abductive reasoning that is involved in fine-tuning arguments, we would not consider this to be a novel prediction. We cannot reason from the observation of fine-tuning to the hypothesis of design, and then subsequently consider fine-tuning to be a novel prediction of a design hypothesis. However, if someone had argued prior to the advent of modern cosmology that such fine-tuning would be found to exist because the universe had been intelligently designed, then this would have presented a loosely falsifiable result. Admittedly, there would be nothing to

prevent the theist from maintaining their theism in the face of such a result – there is no apparent contradiction between the claims that "God exists" and "life can exist in a great multitude of universes" – but as we have discussed, the degree of tentativeness of the proponent is not relevant to the scientific nature of the hypothesis.

These considerations aside, we saw in chapter one that those in the anti-supernatural, anti-separationist camp felt that there might be empirical avenues of investigation which would justify rejecting the existence of God. It is interesting to note that while they obviously disagree on the *answer* to such questions, there are theists who agree with such claims. As Craig offers a slightly different example to Dawkins' "Jesus' DNA" argument:

[I]f the bones of Jesus were to be discovered, then Christianity would be falsified. This is because the resurrection of Jesus is essential to the truth of Christianity. So if Jesus did not rise from the dead, Christianity would be false. So if the bones of Jesus were discovered, that would entail that he did not rise from the dead and so Christianity would be falsified. (2011)

What exactly would be involved in confirming such a discovery, I do not know, but this does offer an *in principle* way of falsifying the existence of the God of Christianity. As before, tentativeness of the proponent has no bearing on the scientific nature of the hypothesis, Craig and Dawkins alike have outlined a theoretically testable hypothesis by which we might scientifically refute the claims of Christianity, a candidate for even the most stringent of definitions of 'supernatural'. As ever, while one might object to the investigability of the claim that Jesus was resurrected on practical terms, the supernaturality of the claim is entirely irrelevant. Were Jesus claimed to have died and been resurrected in modern times, then we would potentially have ample ability to compare any discovered bones to his recorded DNA.

Importantly, and as we shall discuss in the next chapter, these arguments only apply to specific *kinds* of theistic claim. Writing somewhat derisively in *Skeptic* magazine, Pigliucci distinguishes between different brands of theism and the claims that they

make. In particular, he distinguishes between a "metaphysical god", which has no relationship with the physical world, and an "anthropomorphic god", who is more concerned and interactive with the world around us:

If he is not literally running it, he certainly originated and designed it (at least by "picking" the right physical laws. So, god interacts, to a more or less limited extent, with the physical world. Which means that god is somewhat a part of the physical universe. By this definition, the existence of god is a question within the realm of scientific investigation. (1998: 69)

Pigliucci goes on to list several ways in which he thinks that science and religion are in conflict, from areas discussed in biology and design, to astronomy, geology and anthropology. Whether he is correct in his assessments is, as with the arguments in favour of the existence of God, beyond the scope of our discussion. However, it is important to note that his examples at least hypothetically allow for scientific disconfirmation of specific theistic beliefs. For example, in discussing astronomy he writes:

Biblically-derived cosmologies put the Earth at the center of the universe, and imply that the Sun rotates around our planet. Copernicus (1543) and Galileo (1632) took care of that hypothesis and of any possibility that the Sun ever "stopped." (1998: 70)

I do not think it needs to be defended that most contemporary theists would reject the notion that the absence of a geocentric universe has any great bearing on the existence of God. However, this returns us once more to the tentativeness criteria. I would not by any means suggest that we could or should force the theist to accept any specific proposition as part of their own theism. If modern Christians do not believe that the existence of God necessitates the existence of such a universe, then it is not the place of scientists to tell them otherwise.

While scientists might not be able to tell theists what they believe, however, this does not preclude them from investigating the claims that *theists themselves say they believe*. While deciding whether or not a young Earth is important to the truth of Christianity is the duty of the theologian or the philosopher, not the scientist, the job of deciding whether or not the Earth *is* young falls squarely in the domain of the

latter. A scientist is, so far as we trust the claims of science, entirely within their jurisdiction in declaring that any belief that the Earth is 10,000 years old, whether religious or otherwise, is false.

At this point I should draw attention a slight subtlety that may be overlooked. While we can make an easy distinction between "what supernaturalists believe" and "what supernaturalists do not believe", or rather "what supernaturalist X believes" and "what supernaturalist X does not believe", this is not quite the same as the distinction between "what supernaturalist X believes" and "what follows logically or empirically from the premises set out by supernaturalist X". I am not advocating handing the reins of designating the limits of scientific investigation of the supernatural exclusively over to supernaturalists. If the astrologist claims that those born under a certain sign of the zodiac will be more likely to possess certain tendencies then, unless there is some additional qualification of that claim from within astrology itself, the testable implications of that claim are open to be deduced by the astrologist and non-astrologist alike.

This distinction between that which supernaturalists believe and what follows from a particular supernaturalist belief has been given extensive and divisive attention in the many discussions of the problem of evil or suffering. It is not controversial among theists or atheists that some degree of suffering²⁸ exists in the world. What is controversial is whether or not the non-existence of such suffering follows from the existence of an omni-attributed deity. This is a broad and complex area of philosophy of religion, much of which shall not be relevant to us now. Notably, we shall not concern ourselves with discussion of logical versions of these problems. This is due to their focus on *a priori* rather than empirical considerations, which are already too distanced from our current conception of science to be usefully discussed here. Rather, we shall focus our attention on the appropriately labelled 'evidential' formulations of the argument. One famous example of such an argument, offered by William Rowe, is as follows:

²⁸ The existence of "evil" is somewhat debatable, though this is perhaps more of a semantic issue than a theological one.

- 1) There exist instances of intense suffering which an omnipotent, omniscient being could have prevented without thereby losing some greater good or permitting some evil equally bad or worse.
- 2) An omniscient, wholly good being would prevent the occurrence of any intense suffering it could, unless it could not do so without thereby losing some greater good or permitting some evil equally bad or worse.

[Therefore]

- 3) There does not exist an omnipotent, omniscient, wholly good being. (Rowe, 1979: 336)

What makes Rowe's version of the argument particularly relevant is that the first premise may be submitted to actual investigation. Though he uses the hypothetical example of a fawn dying slowly in a forest fire as an example of such an evil, we could reasonably conceive of many actual examples of such suffering.

It is important to note an objection here that although the notion of "suffering", particularly as an example of "evil", is perhaps too contentious or ethereal to be scientific, this is not actually necessary for the argument to undermine separationism. While I would certainly agree that a question such as "What is evil?" is a question better suited to the realms of philosophy and theology, once that question has an answer, then the question "Is there evil?" is a clearly empirical one. If, as with design, we suppose that *some* criteria for suffering be established, either by philosophical argument, or theological interpretation, then we are rendered free to investigate the physical world for examples of it. In this particular case, Rowe has taken suffering to be an example of such a criterion.

Of course, a second, and more compelling objection to applying scientific methodology in Rowe's argument is that the premise requires not just suffering, but suffering which is not necessary for the existence of some greater good, or the avoidance of some worse outcome. Indeed, much of the philosophical work surrounding the problem of suffering and the problem of evil has been the establishment of theodicies designed to explain exactly why the evil seen in the world *is* necessary for the existence of some greater good, or the avoidance of some

greater evil. Perhaps most notably John Hick's "soul-making theodicy" ([1966] 2010: 253-261) and Plantinga's "free will defence" (1974: 165-167).

What makes the evidential problem of evil particularly interesting to our discussion is that two prominent ways of defending it map extremely closely to the kind of scientific reasoning we commonly accept in other areas of investigation. The first, as Rowe himself defended, is that we can use inductive reasoning to justify our belief that no overriding good exists which would accompany particular instances of gross evil. He argues that, where E1 refers to the case of the fawn, and E2 refers to the situation of a 5-year-old girl who is raped and beaten by her mother's boyfriend that: "No good state of affairs we know of is such that an omnipotent, omniscient being's obtaining it would morally justify that being's permitting E1 or E2" (1991: 72). Thus the argument is supported by an explicit appeal to empirical observation.

Rowe argues that, as with other similar inferences, we are justified in believing that no such state of affairs exists by way of induction. Since all of the states of affairs we know of fail to justify permitting either E1 or E2, we can reasonably infer that no such state of affairs exists. Strange as it may seem, given sufficiently fleshed out criteria, then this reasoning is entirely in line with that which we accept as scientific when applied to questions about physics or biology. The only difficulty involved in rendering this scientific is the initial philosophical or theological step in actually establishing what those criteria are, but this poses us no problem. If the theologian makes the claim that "evil can be understood as X, and moral justification can be understood as Y", then the scientist can (in principle) investigate whether or not X exists in the absence of Y.

Of course one may disagree that suffering, even to an excessive degree, is an example of evil. However, this provides no difficulty to the opponent of separationism here. We can defer to the theist to outline their position on what it is that constitutes evil, and allow the scientist to work from there. Although not all conceptions of either suffering or evil will be amenable to such investigation, the fact that some in principle could be means that it is not the case even in so classically a

philosophical and supernatural area as the problem of evil that science must remain entirely mute. It is not the burden of the anti-separationist to argue that *all* supernatural phenomena *do* fall within the domain of science, but rather only that *some* supernatural phenomena *could* fall within the domain of science.

The second type of reasoning with which we might move from the existence of suffering to the conclusion that God does not exist is once again by appeal to abductive reasoning. This is, as we have seen with the discussion of multiverse theory, somewhat more controversial. However, as science finds itself at something of a crossroads regarding what does and does not constitute scientific reasoning in regards to the multiverse, it is worth raising this point here.

One way of approaching this idea is through what Draper offers as an alternative to the theistic position, which he calls "the Hypothesis of Indifference": "neither the nature nor the condition of sentient beings on earth is the result of benevolent or malevolent actions performed by non-human persons" (1989: 332). Draper goes on to argue that, given our observations of the pain and pleasure experienced by humans and animals (though we could reasonably substitute other observed criteria here), then the Hypothesis of Indifference *explains* these observations much better than theism does.

As with previous arguments, I make no claim here as to whether or not Draper is correct in his evaluation. What is important to our discussion, rather, is that if we agree with some defenders of the scientific status of multiverse theory that this kind of reasoning is viably scientific, and moreover that this kind of reasoning can be extended beyond the borders of our universe, then we once again find ourselves with no obstacle to the scientific investigability of a supernatural claim *by virtue of it being supernatural*. While one might object to abductive reasoning in principle, or disagree with the idea that the Hypothesis of Indifference is a better explanation for the data than is theism, or even disagree that we have the ability to verify whether or not our observations of pain and pleasure are accurate, none of these objections hinge upon the supernaturality of any of the claims involved. If the evidential

problem of evil could, in theory, be rendered scientific in all other aspects, then it would not be justifiable to exclude it from science simply on the grounds that it referred to supernatural phenomena unless, as before, one also rejected multiverse theory on the same grounds.

Theism underpinning science

Before we conclude this chapter, there is a further issue that arises when we adopt this conception of the supernatural. That is, a conception whereby the supernatural is defined in such a way as to render the set of supernatural things, and the set of God-like things roughly coextensive. As Plantinga suggests along similar lines, that naturalism can be understood as: "the idea there is no such person as God or anything like God" (2010: 247).

We have discussed the concept of methodological naturalism several times throughout the course of our investigation as the suggestion that science operates by *methodologically* assuming *metaphysical* naturalism. That is, that although scientists are not philosophically committed to metaphysical naturalism, this principle serves as a methodological tool for investigation. As Draper argues when he suggests his weaker conception of methodological naturalism, we should assume metaphysical naturalism for the purposes of investigation, until we have reason not to do so.

We might be inclined to assume that, since science investigates the 'natural' world, that taking naturalism to be the assumed default position for science is somewhat reasonable. Science operates, we have seen suggested, according to the workings of natural law. If we allowed for the possibility of scientific investigation of the supernatural, if conceived of as violations of such laws, then the whole system would fail to operate.

However, while this kind of argument is not without merit, there is an alternative way of perceiving the situation by which naturalism is not only unjustified as a default assumption for science, but outright contradictory to it. I shall outline briefly two such views, the first an adaption of an argument from John Foster, and the second, a more explicit argument for the position from Plantinga. Beginning then with Foster:

The basic regularities of nature cannot be explained in terms of other natural regularities. So how are they to be explained? Well, it might be suggested that any explanation will have to be in *supernatural* terms – that the basic regularities form the terminus of explanation within the framework of the natural realm, and that the only way of accounting for them would be to suppose that there is something *outside that realm* which is responsible for their obtaining. (2001: 148-149)

He goes on to argue that a law of nature cannot be construed as a mere observed regularity, but rather as "the causal necessitation of the regularity *as such*" (2001: 158), arguing that only by viewing the law of nature in this way are we able to support counterfactuals and the like:

It is only when the regularity is imposed *as a regularity* that it comes to embody a restriction on what *could have* happened and what is *capable of* happening, as well as forming a common factor in what *does* happen. (2001: 159)

Again, we are not here assessing the validity of this argument. Though we have seen that it is far from alone as an objection to Humean accounts of natural law.

While Foster uses this reasoning in order to argue for the existence of God on the basis of the existence of the regularities we observe in nature (and thus this could be considered a further example of natural theological argument, albeit more complex in its relationship to science) I would suggest that we could reverse his reasoning in order to apply a direct criticism to methodological naturalism. If Foster's reasoning is sound, then the only justification we have for assuming that the laws of nature will continue to operate in a scientifically predictable manner is through appeal to supernatural explanation. If this is the case however, and we accept the idea that science requires an assumption of predictability, then we must actually assume

methodological supernaturalism to be true in order to conduct scientific research. The arguments we have encountered regarding the unpredictability of the supernatural as an argument in favour of separationism would actually wind up as an argument *against* it.

I shall leave this conclusion unexamined for a moment, and turn to the argument from Plantinga. Known as the "evolutionary argument against naturalism" this second argument has been defended in slightly varying forms by Plantinga since his first formulation in *Warrant and Proper Function* in 1993. He argues that, if both naturalism is true (N), and our cognitive faculties have developed in the way proposed by contemporary evolutionary theory (E), then the likelihood that our cognitive faculties are reliable (R) is low.

Supporting this position, he posits "Paul", a prehistoric hominid faced with surviving an attack from a tiger. Plantinga argues that there are numerous behaviours that would be beneficial to Paul's survival, notably fleeing, and that these behaviours will be acted upon by natural selection. If Paul's behaviour is such that he does not get eaten, then he will survive to pass on that behaviour-inducing mechanism.

The problem, however, is that we need not ascribe any specific belief to Paul in order to bring about such behaviour. While we might be tempted to say that Paul flees from the tiger because he does not want to be eaten, any number of beliefs could cause similar actions (assuming that belief plays a causal role in action at all):

Perhaps Paul very much *likes* the idea of being eaten, but whenever he sees a tiger, always runs off looking for a better prospect, because he thinks it unlikely that the tiger he sees will eat him. This will get his body parts in the right place so far as survival is concerned, without involving much by way of true belief. (Of course we must postulate other changes in Paul's ways of reasoning, including how he changes belief in response to experience, to maintain coherence). Or perhaps he thinks the tiger is a large, friendly, cuddly pussycat and wants to pet it; but he also believes that the best way to pet it is to run away from it. (1993: 225)

Continuing the argument, Plantinga notes that if N and E are true, then the likelihood of R is low. If the likelihood of R is low given N and E, then this provides a defeater for R given N and E. But if we have a defeater for R given N and E, then this defeater also applies to any beliefs we hold, *including N and E*. Therefore, "one who accepts N&E thereby acquires a defeater for N&E, N&E is self-defeating and can't rationally be accepted" (2011: 345). Put more simply, the belief that naturalism is true and that our cognitive faculties have developed along evolutionary lines is self-undermining because it leads to the conclusion that our beliefs are unreliable.

What bearing then, does either of Plantinga's or Foster's arguments have on the question of methodological naturalism? Well, if either argument is sound, then this would illustrate that science cannot operate on the assumption that naturalism is true²⁹. In the latter case, because the 'fundamental' assumption that the world operates according to predictable natural laws could not be justified, and in the former case because no assumption at all could be justified whilst also accepting one of the most prominent theories in contemporary science.

I do not, by any means, wish to argue that I think that either of these arguments, or any that lead to a similar conclusion, are sound. However, what I do wish to argue is that it is at least a requirement of the separationist position to work on the assumption they are not. Thus the separationist is not advocating a neutral or impartial philosophical position at all. In order to take naturalism to be the neutral methodological position for science, then we need to assume that science can function in the circumstance that either metaphysical naturalism is true, or that metaphysical non-naturalism has no bearing on the ability of science to function.

It might, were it necessary, be reasonable to adopt either of these assumptions given that science has an admirable track record of success. However, as I have tried to argue over the course of this discussion, the difficulties in understanding the term

²⁹ Assuming, as we are, that science is in some sense involved with seeking truth. Science could, much like Paul, theoretically operate entirely successfully independently of this assumption, but then any discussion of conflict or concord between science and religion would be redundant.

'supernatural' render methodological naturalism barely coherent, let alone necessary for scientific investigation. What renders a hypothesis scientifically investigable may involve a number of factors, but so far supernaturalism has not been relevant on any interpretation of either science or the supernatural. Thus, making philosophical assumptions regarding the role of the supernatural in science, *especially* under the banner of rejecting such assumptions, is both an unnecessary and unjustified restriction on what it is that science is, and what it is that science could be. The neutral methodological position for science is therefore one that needs make no reference to either naturalism or supernaturalism.

Conclusion

I must be clear that I am not here advocating explicitly that arguments from natural theology are legitimately scientific. Though I do not consider this wholly implausible, determining that issue is part of a larger demarcation project which is wider than the aim of this thesis. What I am instead arguing is that the considerations that would exclude such arguments from science have no relation to the supernaturalism of their subject matter. Even if there is a blunt distinction between philosophical argument and scientific method, we are not bound to assume that arguments surrounding theism, or the supernatural at large, belong in the former.

Although I have discussed each argument individually, the idea that the arguments in natural theology might be scientific is best seen if they are viewed as a cumulative series of inferences. The *kalam* argument, if sound, gives us reason to think that there exists a cause that lies outside the bounds of space and time. Regardless of whether we consider this cause to be God, on the current conception of supernaturalism, this cause would be supernatural by definition. Design arguments seek to tell us something about that cause, as well as to offer further evidence for its existence. If these arguments are at least potentially sound, then this would allow us in principle to make inferences regarding a supernatural entity from empirical

observations, thus undermining even the weak separationist position. Fine-tuning arguments work similarly to those from design, allowing us to once again make inferences regarding an extra-universal entity from empirical observation of the world around us. Interestingly, there are striking similarities between this latter class of arguments and some inferences to a multiverse. Importantly, the objections to the scientific status of each of these sets of inferences have little to do with supernaturalism.

On the other side of the debate, arguments from natural atheology offer us not only further insight into the investigability of supernatural hypotheses, but further establish the potential for earlier arguments to be falsifiable. While these arguments may not comprise, even potentially, anything close to scientific theory, to say that science is mute on such matters seems wholly implausible. The magisterium of science simply is not non-overlapping with these issues.

Finally, though again I make no comment as to the soundness of the arguments in question, the considerations forwarded by Foster and Plantinga give us reason to question the assumption that methodological naturalism can be taken as in any way a 'neutral' position with respect to supernaturalism. We can no more grant that metaphysical naturalism is a working assumption of science than we can grant the same status to metaphysical supernaturalism without a great deal of philosophical legwork. The burden of proof once again, at least in the domains outside of abstract philosophy, rests with the separationist. As metaphysical naturalism carries with it the assumption that no supernatural basis is necessary for either the regularities seen in nature, or our capacity to understand them, then to say that this is an assumption with nothing to say on the validity of theism seems contentious at best. If methodological naturalism is to be defended, it cannot be done so at present by appeal to the kind of "respectful discourse" Gould appealed to in presenting his NOMA principle (1997: 62).

Chapter 7

Outcomes, limitations, and the relationship to demarcation

In this final chapter we shall take stock of the discussion and clarify exactly what it is that is being argued from the considerations given thus far. This will be divided into three distinct, but overlapping sections. Firstly, I shall summarise the main lines of argument that I am forwarding: primarily, that the separationist position is unjustified, and should not be held as a principle of scientific practice; and as a secondary point, that although the term 'supernatural' may be used in a colloquial sense, it is too unclear in its present state to help us understand the issues discussed in this thesis.

With these two arguments made explicit, we shall then address some limitations to the primary argument. While I am suggesting that pre-emptive rejection of supernatural claims from scientific investigations is unjustified, I am not arguing that all supernatural claims are scientifically investigable. I will discuss for example potentially unfalsifiable religious claims, as well as the important role of faith in much religious thought. It should be noted however that these specific religious claims by no means represent the totality of claims which might lie beyond the reach of science. For example, as we saw in chapter one, Gould also suggested that questions of art and beauty might be considered distinct from science, and I do not intend to disagree.

Finally, we shall look to the broader aspects of the discussion. This will involve acknowledgement of the relationship between the separationist debate at hand, and the larger demarcation debate between science and pseudoscience. We shall also briefly consider the potential effects on scientific discourse should the separationist position be abandoned. I argue that given the issues discussed thus far, and considering the limitations to be outlined in this chapter, a measured approach to

separation would have little practical impact on the scientific endeavour, though this should be regarded as a strength of the approach rather than a criticism.

Outcomes

I have argued throughout this thesis against a position of separationism between science and the supernatural. Although there is a distinction to be drawn between the 'supernatural' and the 'religious', there is significant overlap in discussions regarding the exclusion of either from the scientific domain. For this reason this conclusion is inseparably linked to an objection to the related idea that science and religion occupy different "spheres" or "non-overlapping magisteria". Neither of these points are made without qualification, and we shall discuss some limitations shortly. Before doing so however it will be useful to make more explicit exactly what is being argued, and what position I am forwarding.

Primary outcome: The supernatural should not be excluded from science

The primary outcome, that we should not exclude the investigation of supernatural phenomena or supernatural hypotheses from scientific investigation, is argued along four major lines. These arguments are threaded throughout the discussion, so do not correspond to distinct chapters, though some have received significantly more attention than others. Let us then break these down into more explicit claims:

- (i) The separationist position does not provide a middle ground between science and the supernatural, nor science and religion.*

Rather than encouraging "respectful discourse" (Gould, 1997: 62), the separationist limits the abilities of both proponents and opponents of the existence of the supernatural to defend their positions by appeal to scientific evidence. Moreover,

the position fails to find a cultural middle ground between supernaturalists and anti-supernaturalists, being opposed both by the ardent supernaturalists of the Intelligent Design movement, and also ardent anti-supernaturalists such as Dawkins.

While one might be tempted to argue that the separationist position reflects a more 'moderate' view than these two camps, it does not reflect moderation at all, but rather another extreme point of view on an orthogonal issue. The view that science cannot investigate supernatural claims does not lie somewhere in the gulf between "strong supernaturalist" and "strong anti-supernaturalist", but rather lies at one end of the spectrum between "separationist" and "anti-separationist". More problematically, by actively eliminating a point of common ground – the ability to discuss matters scientifically – the separationist position erects a wall, rather than a bridge, between the two former positions. The defender of supernaturalists claims is denied the chance to offer scientific evidence in support of their claims, and the detractor is similarly stifled. If there is scientific evidence available for either position, then the separationist denies both parties the opportunity to present and discuss it.

(ii) The terms 'science' and 'supernatural' are too ill-defined for any consistent justification for exclusion to arise.

Although we will discuss the relationship to the broader demarcation debate towards the end of this chapter, it is worth noting here the sheer breadth of interpretations of what it is to be 'scientific' touched upon in this (non-exhaustive) overview of the topic. What is more troubling, even for those who might consider the demarcation debate somewhat settled, is the additional dimension of defining the supernatural. The suggestions that have been forwarded here, such as "that which violates the laws of nature", or "that which is external to space and time but can affect that within space and time", are tentative at best. We have seen the difficulty in coherently understanding such notions, especially without circular appeal to the 'natural'. Even if such terms could be accepted, they bear little relation to common usage, and suggest little reason to accept a separationist account. This is

not simply to say that the definitions given so far are vague, but that it seems plausible that there are no legitimate ways to make them more precise. This is particularly true of supernaturalism, which we shall discuss in the secondary outcome.

In any case, it seems at least prudent to be cautious regarding the state of the debate regarding what it is to be either scientific or supernatural. Given such caution, sweeping declarations about how the two might interact seem somewhat premature, especially in the legal domain. This remains the case even if we grant that philosophy has any business speaking about what it is that scientists can and cannot do.

(iii) Even if we grant that both terms can be well-defined, still no justification for separation arises on the most common understandings of either science or the supernatural.

We have looked at a number of the most prevalent conceptions of science and the supernatural, and seen that in no circumstance could a reason for separation be located in the supernaturalism of a claim, rather than in some other unrelated issue. Often, this will involve practical (and contingent) impediment to testing, or else appeal to qualities of the supernatural phenomenon in question which cannot be established prior to investigation. While it is not useful to repeat these discussions here, even in the most tenuously scientific area of natural theology, the most compelling argument for exclusion is in the philosophical nature of the discussion, rather than the content itself. In this area especially, it can be seen that these problems undermine even a weak form of separationism.

(iv) Even if some reason for exclusion could be shown to arise for a specific understanding of science and the supernatural, these understandings would be so esoteric as to render their application unjustified.

We have discussed a selection of the most well-known criteria for science and the supernatural and found no conflict, but it is always possible that some unconsidered criteria might be identified where conflict does in fact arise. However, even in this scenario, such understandings would be so esoteric as to require significant philosophical work on the part of the separationist to demonstrate that the conclusion could, or should, be universalised. While this is certainly an area for interesting further research, I maintain that the burden of proof rests with the separationist when it comes to advocating the separation between science and the supernatural in anything more than an abstract sense. The history of separationism in the domains of science, law and politics is simply not justifiable according to the current state of the philosophical debate.

In summary, the separationist position is neither helpful, nor justified. Moreover, as this is not simply an issue of philosophical curiosity, but a matter with practical implications for policy in both the sciences and the legal system, the premature application of this position is something that should be avoided. Whilst it is easy to sympathise with those who have worked to keep Intelligent Design out of science classrooms in favour of accepted and rigorously tested theory, the measures taken to achieve this goal have stepped well over the bounds required to achieve the task. An enormous amount of philosophical investigation is required before the erection of any artificial barrier between domains would be defensible, and we have seen that no natural barrier is evident where it is suggested that it might be placed.

Secondary outcome: The term 'supernatural' does not belong in rigorous discourse

A secondary argument that I am forwarding is that the term 'supernatural' is, at least within the context of rigorous debate, unhelpful to the point of damaging. This secondary point is argued much more weakly, and a greater deal of work is required in order to defend it, but I raise it as a potentially important outcome of the discussion, and also as a theme that has caused consistent difficulty throughout.

We have seen that there is little consensus as to what the term 'supernatural' actually covers. Without appeal to circular notions regarding "that which is not natural" there is little, if anything, to pick it out. Moreover, where a more promising definition is articulated, it bears little resemblance to common usage, nor offers much in the way of practical import. Definitions which limit focus to the non-physical render countless examples of commonly conceived supernatural entities (such as vampires, unicorns and werewolves) natural, whilst potentially rendering the human mind supernatural. Definitions which focus on externality to nature, even if rendered coherent, potentially add even further examples to the natural world (for example ghosts and spirits, though this is somewhat complex), whilst rendering certain interpretations of multiverse theory supernaturalistic, or at least non-natural.

While definitions which focus on violations of natural law might seem more promising in terms of correspondence to common usage, upon closer inspection they barely achieve coherence, let alone offer us a legitimate category about which we can make comment, or regarding which we can draw inference. If any supernatural phenomenon actually occurred, then on many accounts it would no longer be coherent to discuss a 'law' that existed for it to violate. Or, at minimum, we would no longer be epistemically justified in believing that the law it was said to violate was, in fact, a law. Although there are some accounts which may admit of such violations, notably Ramsey-Lewis' systems approach and accounts which take natural laws to describe tendencies, these rely on an understanding of violations as being the kind of non-repeatable events we commonly understand as 'miracles'. While this is a potentially viable definition of 'miracle', it would not seem to include other phenomena such as ghosts or vampires which, if existent, would not fit into such a definition. Moreover, as we have seen in the example of the Catholic church's investigations for the purposes of beatification and canonisation, it is not obvious that such 'miracles' could never be approached scientifically.

Ironically, one of the most plausible definitions of the supernatural might be "that which science cannot investigate". Clearly, this is of no use whatsoever in the

demarcation debate, but it would at least plausibly offer us a set of entities about which we could make interesting claims. Unfortunately, as with other definitions, it bears little resemblance to common usage of the term, and also appears troublingly relativistic. Were distant stars 'supernatural' prior to the development of telescopes powerful enough to see them? Would ghosts be 'natural' if they appeared with a frequency conducive to scientific study? Intuition seems to suggest that the answer to both of these questions is "No". Regarding the status of theoretical entities, Grover Maxwell argues that our ability to observe them "at any given point is an accident and a function of our physiological makeup, our current state of knowledge, and the instruments we happen to have available and, therefore [...] has no ontological significance whatever" (1998: 1061-1062).

Indeed, it seems that much of the commonly held supernatural pantheon would be rendered 'natural' should they actually be discovered to exist. In tales of myth and fantasy, supernatural phenomena are often described as entities with predictable and testable behaviour: a vampire will die if exposed to sunlight; ghosts cause people to feel cold upon contact, or leave behind an ectoplasmic residue; removing the head of a hydra will cause two to take its place. Seemingly outlandish as all of these claims are, they are all open to empirical testing. Should vampires, ghosts, or hydras be observed in the natural world, then it seems implausible that scientists would make no efforts to investigate them, and presumptuous of philosophers to tell them they would not be allowed to do so.

One might be inclined to find discussion of such examples too fantastical for serious discussion. However, I would argue, this actually serves to emphasise the point. I have selected here some of the most recognisably 'supernatural' phenomena we can think of in terms of the popular discourse, and even here in the most outlandish of areas the label seems to be a poor fit. While one might argue that there is no place for discussion of such entities in serious academia, what academic function then can the term 'supernatural' reasonably be thought to serve? The less fantastical the types of entities we attribute it to, the closer to the 'natural' they become. Thus the more one is inclined to think that there is no place for serious discussion of any

particular supernatural entity, the more difficult it becomes to retain any semblance of meaningful content for the term. This is particularly problematic for the separationist who wants to assert that "science cannot investigate the supernatural", as this proposition relies on the latter category actually having at least intensional, if not extensional, meaning.

With that said, while I am arguing for the exclusion of the term 'supernatural' from academic and legal deliberation – at least in regards to its relationship with science, I am not arguing that it should be excluded from common parlance. Clearly, as we have seen over the preceding chapters, we are capable of employing the term in some kind of communicative capacity. That there is no plausible philosophical understanding which could capture common usage does not undermine the fact that such common usage does occur. If I am told that a book contains 'supernatural elements', then I am able to make some sense of that claim through familiarity with the way the term is usually employed. Whether or not the magic or goblins or ghosts featured in the story should be 'naturalised' in a sense which could be more rigorously defined is not something which need concern a general audience and need not undermine the practical usefulness of the term.

The ghostly elephant in the room

There is, I think, one issue relating to this debate which is avoided in many discussions and which requires some attention. This is, however, an issue that will need to be treated with some care. Consider, as we saw in chapter one, that the following two facts obtain:

- (i) Belief systems featuring supernatural claims are frequently placed into the category of 'pseudoscience'.
- (ii) The term 'pseudoscience' is a pejorative term.

Consider furthermore, Pennock's comments on geocentrism and creationism from chapter two:

Take the geocentric view of the world, which is still advanced by some creationists. While one may say that such a claim was historically scientific or even that it remains scientific in the abstract sense that it is testable, it would nevertheless be fair to conclude, because this claim has been decisively disconfirmed (at least under the assumptions of MN), that it is unscientific to continue to hold and teach it today. The scientific picture of the world does not include claims that have been decisively refuted and effectively relegated to the dustbin of scientific history. (2009: 557)

Given this attitude from Pennock, and the acknowledgement that pseudoscience is indeed a term of criticism, we are I think justified in thinking that *in some cases* the inability of science to investigate the supernatural is defended on the basis that the supernatural is assumed to be nonexistent. Obviously however, as we have seen many examples of pro-supernaturalists advocating separationism, this is not always the case.

Compounding this suspicion is the fact that, from a practical perspective, the separationist position allows for significant benefit to naturalistic members of the scientific community. Or, to return to our parlance from chapter one, to anti-supernaturalistic opponents of creationism. Put simply, the separationist position allows for anti-supernaturalist scientists to go about their work without having to risk offending supernaturalists by openly stating that their views (for example creationism) are false. In a world where concerns of funding in science are highly important, and a large proportion of taxpayers are supernaturalist, this is no trivial concern. As we have seen, these concerns are also highly relevant within education, where the separationist position offers a convenient method for keeping creationism out of science classrooms, without having to present it as false.

In order to address this issue, let us consider an extreme example, distinct from any religious connotations. We have occasionally touched upon examples of this sort throughout our discussion, such as ghosts and goblins. These kinds of phenomena are distinct from other examples, such as miraculous healings, in that there is little controversy over whether or not they are to be considered 'supernatural'. In the case of supposedly miraculous healings, it is the supernaturality of the phenomena we question, whereas in these examples it is the existence of the phenomena itself.

As we have not arrived at any useful definition of the supernatural, we shall have to rely on intuitive or common usage, though I do not think this will pose a problem for the purposes of discussion here. Imagine that in the room in which you are currently sitting, and in rooms around the world, there stood the ghost of an elephant: how would scientists respond to this phenomenon?

Given our prior discussion, there seem to be four main possibilities:

- 1) Separationism would be insisted upon, and scientists would ignore the ghostly elephants entirely.
- 2) Separationism would be maintained as a principle, but the ghostly elephants would be declared 'natural' and investigated.
- 3) Separationism would be abandoned, and the ghostly elephants would be investigated, despite being regarded as supernatural.
- 4) The separationist principle would be rearticulated in terms of religion, rather than supernaturalism, thus allowing for investigation of the elephants, but without abandoning separationism entirely.

There may of course be alternative responses (surprise and fear notable inclusions), but I think these represent the significant approaches for our purposes. Let us consider them in turn.

The first option is, I think, highly implausible. If I am correct, then this seems fairly telling regarding the separationist position. This is of course entirely speculative, but I leave it up to the reader to decide if this view is controversial. I follow Boudry in suggesting that:

[I]f supernatural forces were operating in the natural world, producing tangible empirical effects, as many theists maintain, nothing would prevent scientists from empirically investigating those [...] narrowing down the scope of science by excluding all supernatural claims from its purview is unfeasible and historically inaccurate, given that many such claims have in fact been subjected to empirical investigations (e.g., the healing power of intercessory prayer, clairvoyance, communications with angels). (2013: 85)

The second option is significantly more plausible, and as indicated by Boudry, perhaps historically justified. If we accept the history of science in which lightning and earthquakes went from being considered acts of deities to naturally occurring

phenomena, then it seems that this approach has in fact been adopted many times over the centuries. To quote Pennock: "If we could apply natural knowledge to understand supernatural powers, then, by definition, they would not be supernatural" (1999: 290). However, this approach pays no more than lip service to separationism, and returns us to our definition of 'supernaturality' in which the supernatural is understood simply as that which science cannot investigate.

The third option, which I am arguing for in part, would hopefully be adopted by many, though historically it is perhaps less likely than the previous alternative. It should be noted though that when I describe this situation as occurring "despite being regarded as supernatural", I mean this in the colloquial sense, rather than in a way that attributes proper meaning to the term 'supernatural' itself. I concur with the notion that ghostly elephants, if existent, would not be meaningfully distinct from the natural world, as advocates of option two would argue. Where I disagree with those advocates is that I reject the notion that we can understand a meaningful demarcation between the natural and the supernatural, where ghostly elephants currently belong on one side, but would move to the other side upon actually being observed.

The final option is one which, although I favour complete abandonment of separationism, I think represents a reasonable compromise position, and one which will be further articulated later in this chapter. As well as being more in line with the NOMA principle, and involving a greatly reduced limitation on scientific investigation, it also alleviates a further problem with the term 'supernatural'. We have focused in our discussion primarily on the difficulty in the relationship between science and the supernatural, but in arguing that the term should be abandoned we can also appeal to the relationship between religion and the supernatural, which as we have seen are often conflated in the literature on demarcation.

Although I do not wish to engage in a prolonged discussion on the relationship between religious claims and supernatural claims, I will simply note here that pursuant to the difficulties we have already encountered, it seems absurd, perhaps

even offensive, to attempt to utilise the same term to pick out the God of Western theism (or the sacred beliefs of any religious person) as is used to pick out vampires, unicorns and elephantine spectres. That there is no useful purpose from a scientific perspective in employing the term only serves to reinforce the redundancy of appealing to the 'supernatural' rather than the 'religious', if any concession is to be made to separationism at all.

Limitations

While I have argued for the rejection of the separationist position, and to a lesser extent the rejection of the term 'supernatural' from academic discourse, these arguments do come with some qualification. Although there should be no rejection of a hypothesis from science on the grounds of 'supernaturality', that is not to say that any and all phenomena to which we might commonly ascribe the term 'supernatural' will be susceptible to scientific investigation.

Any impediment to scientific investigation that can be applied to 'natural' phenomena may also be applied to the supernatural. While I do not think that the property of being supernatural is in itself an inherent obstacle to a phenomenon being scientifically investigable, nor do I think it removes more mundane obstacles that might impede investigation. The unpredictability, or disconnection from the causal nexus we have seen forwarded as defences of the separationist position, whilst ineffective in that regard, may indeed prevent scientific investigation of a supernatural, or natural, hypothesis. As we discussed in reference to the multiverse, if we reject the kind of abductive reasoning that might lead us to infer a causally disconnected set of universes as scientific, then we would also be bound to reject the same kind of reasoning in inferring a deity. That the former is more intuitively 'natural' than the latter has no bearing on the discussion and, as we have seen, it is unclear that either can be confidently categorised as natural or supernatural in anything more than a loose sense.

The impediments to scientific investigation may well be more prevalent in the case of supernaturalist hypotheses, especially if we consider the kind of supernaturalist claims discussed in chapter six whereby the supernatural is thought to be 'beyond' the natural world. In an interesting argument defending the verifiability of God's existence, Hick has argued for the possibility of attaining certainty of His existence post-mortem by appeal to specific confirmatory experiences in the afterlife: namely, "an experience of the fulfillment of God's purpose for ourselves, as this has been disclosed in the Christian revelation, and [...] an experience of communion with God as he has revealed himself in the person of Christ" ([1957] 1988: 187).

What is surprising about Hick's example is that, even in as outlandish and non-naturalist a context as this, the apparent impediments to considering this situation scientific are highly mundane. Most notably, no one would be able to communicate their findings back to the scientific community and, as Hick himself argues, the experience could offer only verification for, but not falsification of, the claim that God exists.

While it is true that the inability to communicate findings, and the inability to falsify the claim, are both caused by the supernaturality of Hick's scenario, it is *not* the supernaturality itself that renders God's existence unamenable to investigation by science. This can be seen by taking the scenario even further. Imagine, rather than the God of Christian theism, that some other deity were hypothesised. This deity, rather than taking the dead to an afterlife for any extended duration, did so only for a very temporary period, and then only if that person was a professed believer. Upon returning a believer to life, their body would be restored to its state prior to whatever fatal incident had caused them to die. Moreover, any person who died would be returned to life with an intricate and complete knowledge of the holy texts relating to that deity.

This adapted situation would lead to remarkable, but highly testable results. Believers and non-believers in the deity could be lined up and, permitting a sufficiently amoral ethical code, be executed in the most categorical of ways. Shortly

after, those who had professed belief could be observed to return to life, regardless of whatever horrific state they were put in during their execution. They could then be tested on their knowledge of the religious texts in question, and this knowledge compared to their prior understanding. Those who did not profess their belief, assuming any non-believers actually existed in such a world, could be observed to remain deceased.

This scenario can be adapted and adjusted further to accommodate any objections that it is not 'scientific' enough, or that alternative naturalistic explanations could be put forward. The knowledge gained could be rendered more specific to the circumstances of the death. The duration of the time pre-resurrection may be similarly alterable in a way that submits itself to a greater degree of prediction and falsification. What is relevant here is that the supernatural nature of the scenario, assuming we grant that Hick had described a scenario which could accurately be described as supernatural in the first place, would not inhibit scientific investigation.

It is interesting to note here that one cannot object to this new scenario on the grounds that, unlike in Hick's set-up, scientists are only able to observe the resurrection from 'within' the natural world. In Hick's example the observer only received confirmation of the supernatural hypothesis once they entered a supernatural realm themselves, but the scientists in the adapted scenario are able to view humans dying, resurrecting, and presenting increased knowledge without ever themselves leaving the natural world, or without ever observing any supernatural entity at all. While this is indeed a difference between the examples however, it does nothing to undermine the anti-separationist case. If Hick's scenario is supernaturalistic in any meaningful sense, then surely so is the adapted version. But if both scenarios are supernaturalistic, then the difference in scientific investigability is not related to the supernatural nature of the situations involved. Hick has presented us an example of a supernatural situation in which scientific investigation may not be possible, but there are many equally plausibly supernaturalistic scenarios in which such investigation seems entirely reasonable. Again, we discussed just such

a scenario in chapter four when we touched upon the process of certifying a miracle for the purposes of beatification and canonisation.

Of course, whilst the deity in this new scenario might be amenable to scientific testing, the more traditional theistic picture is not always one of a God who is so open to investigation. Looking to the atheistic side of the debate, we saw in chapter one Dawkins' scepticism that theists would accept categorical evidence that God does not exist, and later arguments from both Pigliucci and Pennock regarding the unfalsifiability of creationism due to the possibility that God merely created the world with the appearance of age.

This scepticism echoes earlier positivist arguments for the meaninglessness of theistic claims. One famous example forwarded by Anthony Flew, in an adaption of work by John Wisdom, relates God to an "invisible gardener". In Flew's version of the story, two explorers encounter a clearing in a jungle filled with flowers and weeds. One of the explorers believes that there must be a gardener who attends the clearing, whilst the other disagrees. After waiting at the clearing for some time, the first explorer postulates that the gardener might be invisible. In order to test this, the explorers set up various traps in order to detect the gardener, but once again they find no evidence for such a presence. This leads to the following exchange:

Yet still the believer is not convinced. "But there is a gardener, invisible, intangible, insensible to electric shocks, a gardener who has no scent and makes no sound, a gardener who comes secretly to look after the garden which he loves." At last the Sceptic despairs, "But what remains of your original assertion? Just how does what you call an invisible, intangible, eternally elusive gardener differ from an imaginary gardener or even no gardener at all?" (Flew et al. 1955: 96)

Flew may or may not be correct in this assessment that God is unfalsifiable on a traditional, or at least common, theistic conception. If he is, then this would indeed place claims about the traditional theistic God outside of the scope of scientific investigation. Though it is worth noting that the traps set up by the two explorers serve at least as provisionally scientific, even if not amenable to a definition of science that is reliant upon falsification. Moreover, if the gardener in question had

possessed at least one of the qualities that would have activated their detection mechanisms, despite still being invisible, or possessing any of the other ethereal characteristics we might conceive of, then it would seem at least plausible that it might still be considered 'supernatural' despite its detectability. Indeed, returning to non-theistic examples, ghosts and poltergeists are thought to behave in exactly this fashion.

Granting though that Flew's gardener is indeed undetectable and unfalsifiable, then this would present us an example of a supernatural entity that was not scientifically investigable. What makes this a more pressing concern, and one that is perhaps more informative of the state of the debate, is that this conception of God is also forwarded by those who consider belief in His existence to be reasonable. Turning then to the theistic side of the debate, as we saw in chapter one, Rowan Williams and Jonathan Sacks were quick to object to Hawking's conclusion that God was not required to explain the existence of the universe. As with Dawkins' approach, this position echoes earlier philosophical work, particularly those that have emphasised the role of faith in religious belief. As Kierkegaard suggested:

If I can grasp God objectively, then I do not have faith, but just because I cannot do this, I must have faith. If I wish to stay in my faith, I must take constant care to keep hold of the objective uncertainty, to be 'on the 70,000 fathoms deep' but still have faith. ([1846] 2009: 172)

This sort of approach has also been proposed in a more specific form of response to Flew. As Henry Allison argues:

Religious belief, with its requirement of total commitment and complete trust in God, is in its very nature not *because* of but in *spite* of the facts, and thus the believer unlike Flew's theologian or explorer, will neither qualify his belief out of existence, nor admit that it is falsified. (1969: 501)

For Allison, it is not that religious beliefs do not involve propositions that can be true or false, but rather that they cannot be falsified in terms of 'quasi-scientific' analysis. Expressions such as "God loves mankind" do not serve as a basis for prediction as to how we can expect God to act, in the sense of allowing for only a certain degree of

evil or suffering before being falsified, but rather an expression of faith and trust that if we could understand the 'big picture' then we would see that whatever suffering or evil that exists serves some function or purpose (1969: 518). Similar reasoning can be seen in the free will or soul making theodicies already mentioned.

Of course, as we have discussed previously, there is a distinction to be drawn between what a particular person believes and what follows from their belief. Just because Allison does not consider the existence of suffering or evil to weigh against the proposition "God exists", this does not mean that we must agree with him. However, I would argue that, unlike with our discussion of creationism in chapter five, this is an area where one might legitimately argue that the belief in question is unfalsifiable. Whereas creationism, and especially Young Earth creationism, makes claims which are open to scientific appraisal, it is more of an open question as to whether or not Allison's views are similarly investigable. As we discussed in chapter five, there is a difference between the claim "an omnipotent being exists" and the claim "there exists an omni-attributed being whose existence is incompatible with both evil and the appearance of evil".

With these limitations in mind then, we can clarify the position being argued for. We have seen that the separationist position divides religion and science into two distinct spheres. In other words, they accept these limitations outlined above, and extend them from a limited set of specific unfalsifiable claims to the entirety of supernaturalist thought. While I concede that these limitations exist, I do not extend this concession to the whole possible realm of entities or phenomena which might be considered 'supernatural'.

Partially Overlapping Magisteria

If separationists hold to the position that science and religion occupy different domains, with no overlap whatsoever, then the opposing view to separationism would be the view that science and religion occupy identical epistemological space.

Such a view would suggest that there are no questions, or meaningful statements, which fall within only one of these magisteria, but not in the other. Perhaps the most obvious, and common, example of such a view is what Dupré critically referred to as "scientism".

Even if one does not accept the limitations outlined in the previous section, I feel I should stress here that despite arguing that there are supernaturalistic, and religious, claims that are investigable by science, I am emphatically *not* endorsing scientism. Even within the sphere of askable scientific questions, there is no guarantee that an answer could be found, nor that science provides the best method for arriving at it. If the claims of creationists are indeed scientifically investigable, and also happened to be true, then quite clearly theology got there first. Moreover, there are many question types which are not, at least without controversy, scientific. Many questions of morality, meaning, and purpose may well fall beyond of the scope of science, yet still be both meaningful and answerable. Such questions may even relate to explanations regarding the universe if Lennox's arguments from chapter one regarding Aunt Matilda and Henry Ford are to be taken seriously. An important thing to note though is that, again, the divisions drawn here do not fall along the borderlines between the natural and the supernatural.

The position I am outlining is thus a rejection of both scientism and separationism. If separationism reflects a position of no overlap between science and the supernatural, and scientism represents complete overlap (or rather complete subsumption of supernaturalist beliefs by science) then the position I am forwarding is, ironically, an actual middle ground between the two. In terms of religion, rather than supernaturalism in general, this would be akin to what Alister and Joanna Collicutt McGrath term "Partially overlapping magisteria (POMA)", namely the "realization that science and religion offer possibilities of cross-fertilization on account of the interpenetration of their subjects and methods" (2007: 41).

Though I think that considerations of the role of faith in religious belief warrant at least grounds for tentative support for this more moderate view, and the arguments

I have outlined throughout this thesis warrant similar support for the view that some religious claims might be testable, the position that I am forwarding is slightly humbler than POMA. Unless one argues for the position that all supernaturalist claims are religious, which given the breadth of putative supernatural phenomena, as well as the employment of the term 'supernatural' over 'religious' in the literature, seems both untenable and confusing, then there are some supernatural claims which are not religious. If this is the case, then even if there were complete disconnection between science and religion, then *still* the separationist position may turn out to be unjustifiable. There may be hypotheses which are investigable by science, are not religious, and yet are still 'supernatural' under some conception of the notion. The existence of ghosts, the efficacy of dowsing, or the reliability of astrological predictions all seem plausibly to fall within this category.

It is not within the scope of this thesis to outline exactly which phenomena may or may not be investigated by science. I only intend to argue that there is no good reason to suppose that the entirety of the supernatural realm be excluded from such investigation. I have laid out here what I consider to be the basis for further investigation into outlining a more complex and integrated relationship between both science and the supernatural and science and religion. Hopefully this is a position which can be accepted by those on both sides of the supernaturalist divide, and allow for fruitful cooperation and discourse between these domains.

Relationship to the demarcation debate and moving forward

Although we have touched upon many of the topics which arise within the demarcation debate between science and pseudoscience, I make no comment here as to whether or not the debate is, as Laudan (1983) famously claimed, dead. It is worth noting that the relationship between the pseudoscience debate and our current discussion is, to some extent, due to semi-historical accident. As we have seen over the course of this discussion, many putative demarcation criteria have no

bearing on supernatural phenomena at all. Rather it is simply a common occurrence in the literature for creationism, astrology, and other supernaturalist ideas to be frequently referenced as paradigmatic examples of pseudoscientific enterprises.

With that in mind, it is worth qualifying that I am not denying that creationism or astrology are, if such a category does in fact exist, obvious examples of pseudosciences. Rather, what I am arguing is that whatever the ultimate outcome of the demarcation debate turns out to be, the divide between the natural and the supernatural does not seem likely to play a significant role in its resolution. If Laudan is correct, and there are no valid demarcation criteria for differentiating between science and pseudoscience, then clearly no such criteria can apply to supernatural phenomena. Conversely, if there are such criteria, then even if they apply to all supernaturalist activities, then it is not by virtue of supernaturalism that they do so. There are many reasons to think that creationism is a pseudoscience, but the fact that it makes supernaturalist claims is not obviously among them.

Note that I am not merely arguing against the idea that naturalism is a necessary condition for science which, in light of more recent philosophical trends, may in any case be rejected in favour a more subtle Wittgensteinian family resemblance approach to demarcation. Under such a conception, science would be "characterized by a number of threads connecting instantiations of the concept, with some threads more relevant than others to specific instantiations, and indeed sometimes with individual threads entirely absent from individual instantiations" (Pigliucci, 2013: 21). Regardless of whether or not one accepts the idea that there are necessary or sufficient criteria for science however, I am arguing that according to predominant understandings of the term, 'supernaturalism' is irrelevant to the scientific nature of an enterprise except, arguably, by the coincidence of lack of empirical evidence in support of such a position. If there are necessary criteria for science, naturalism does not seem to be sensibly among them.

Although I think a complete rejection of supernaturalism from demarcation criteria is justifiable, even if one does not accept this argument fully, then there is still a viable

compromise available. Mahner (2013) argues for a cluster approach to differentiating science from pseudoscience. Rather than strict necessary and jointly sufficient criteria, he argues for a system whereby only a proportion of indicators of science need to be fulfilled in order to achieve scientific status. Though he hints at appeal to natural law as such an indicator (2013: 38), this approach would allow for a rejection of the separationist position, without entirely abandoning the intuition that supernatural phenomena are not wholly comfortable within scientific discourse. Perhaps this intuition can be satisfied tentatively, with supernaturalism being indicative that a hypothesis or activity is unscientific, but without it being a sufficient criteria for non-science. What proportion of indicators might be required to justify accepting an investigation into the supernatural as scientific is something I do not intend to address here, though it is something that would need to be established in order to avoid science becoming vague-boundaried.

Whether one accepts either a cluster approach, or a more restrictive approach that is reliant upon necessary and sufficient criteria, the notion that science adheres to strict methodological naturalism should, I think, be abandoned. Instead, if demarcation is deemed desirable, then other criteria should be relied upon in order to determine whether or not a hypothesis or activity is scientific. Most simply, regarding hypotheses, would be the suggestion that a better supported, more parsimonious or more commonly observed explanation is to be preferred over a less well supported, less parsimonious, or more exceptional one. As the oft referenced medical adage goes: "when you hear hoofbeats, think of horses not zebras" (Sotos, [1989] 2006: 1)

This approach has the benefit not only of avoiding the imposition of scientific blindness to truth, should it happen to be the case that any supernatural phenomenon actually exists, but also philosophical practicality. For example, by ignoring the natural/supernatural dichotomy, we are able to apply the underlying principles of how we arrive at understanding laws of nature, whatever they happen to be, without engagement with questions over their ontology. We should seek explanations, hypotheses, and laws, which are experientially (or theoretically) well

supported, not those which happen to fall on one side of a delineation so unclear as the distinction between the natural and the supernatural. As Laudan put it:

Rather than taking on the creationists obliquely and in wholesale fashion by suggesting that what they are doing is "unscientific" *tout court* (which is doubly silly because few authors can even agree on what makes an activity scientific), we should confront their claims directly and in piecemeal fashion by asking what evidence and arguments can be marshalled for and against each of them. The core issue is not whether Creationism satisfies some undemanding and highly controversial definitions of what is scientific; the real question is whether the existing evidence provides stronger arguments for evolutionary theory than for Creationism. (Laudan, 1982: 18)

I am not arguing for something as strong as Laudan's rejection of pseudoscience as a term outright, though some may consider my rejection of the term 'supernatural' equally, or perhaps even more, controversial. Instead, at least in my primary argument, I am suggesting that *regardless of whether or not the terms 'pseudoscience' and 'supernatural' pick out any actual kinds* it is not at this point in the history of science justified, or beneficial, to attempt to pre-emptively exclude supernaturalist claims from the domain of science.

Of course, Laudan's suggestion, and by extension my defence of it, has not been without controversy. James Ladyman has responded to Laudan's position on three points: "confronting pseudoscience in this way is problematic: it consumes too much time and too many resources, is not useful when engaging in public debates that operate at general level, and is too detailed for scientifically nonliterate audiences" (2013: 49-50).

Rejecting supernatural phenomena from science by default is certainly easier in principle than a more nuanced approach. However, I would argue that the history of creationism, and its widespread acceptance in the public sphere, suggests that Ladyman's objections do not hold up to historical scrutiny. This is especially true in the case of religious claims, where already the public image of a 'war' between science and religion is further fuelled by wholesale, and seemingly unconsidered, rejection of claims like those made by creationists by science. Surely it is far more

persuasive in the public sphere to say that creationism is not scientific for any of the multiple alternative reasons to which we might appeal (lack of falsifiability, lack of testable predictions, overwhelming support for an incompatible and opposing account and so on), than to attempt to convince a largely supernaturalist public to accept that science adheres, for purely methodological purposes, to the assumption that supernaturalist phenomena do not exist.

What is key, and striking, about an approach of partially overlapping magisteria, combined with an emphasis on evidence-based criteria for science, is how remarkably unrevolutionary it actually is. Discarding the separationist position, or the principle of methodological naturalism, implies no consequences whatsoever for the practices of science, nor the conclusions it draws. Separationism only has impact if (i) naturalism is false and there is evidence to that effect, or if (ii) some supernatural claim is false and there is evidence to *that* effect (as seems plausibly the case with creationism). In neither of these scenarios however, is methodological naturalism desirable.

If the world is naturalistic, then methodological naturalism will have no effect whatsoever. While we might posit supernaturalist hypotheses, as creationists have, then those hypotheses will have to be put under exactly the kind of scrutiny that any other hypothesis would. Creationists would need to engage with the scientific community, submit their ideas to peer-review, present falsifiable predictions, and support their claims with evidence. Given that we are assuming naturalism to be true, they will fail in this endeavour, and creationism will be, assuming we can make sense of demarcation at all, deemed unscientific. The separationist position adds nothing to this whatsoever other than to prevent scientific criticism of creationist claims.

Conversely, if some supernatural phenomena exist, then creationism will still face exactly the same burden in order to be considered scientific. Thus far, it has failed to meet that burden regardless of whether or not one thinks that science adheres to methodological naturalism. However, if naturalism is false, then some supernatural

hypotheses may well turn out to be investigable in a manner that accords with scientific method. By pre-emptively excluding investigation of such phenomena, the separationist has blocked off an avenue for truth-seeking.

Creationism in its current form will no more be considered science tomorrow if methodological naturalism is abandoned than it is today if it stands. Similarly, science will continue to investigate hypotheses based on the evidence and methods available to it. These statements hold regardless of whether or not supernatural phenomena actually exist. The separationist position offers no benefit to the scientific endeavour for the supernaturalist or their detractor, and may only serve to blind science to truths about reality for both.

Conclusion

In the opening chapter of this thesis, we saw that the question of whether or not science can investigate the supernatural is one which has had significant legal and cultural impact over the course of the last century. In order to ease the perceived tensions between science and religion, notably in the context of creationism and evolution, some have argued that these domains should be considered separate. This position has been argued for as a cultural middle ground, allowing for respectful discourse between the supernaturalist and their detractors.

Throughout this discussion I have argued that this separationist approach is misguided. In the opening chapter I argued that separationism fails to properly locate itself within the discussion, occupying not a middle ground between the extremes of religion and irreligion, but rather placing itself in opposition to people in both camps. This is easily seen when we view the debate not as a singular spectrum, but rather as a two-dimensional grid of beliefs.

In addition to this issue with cultural context, I maintain that separationism itself is untenable. Although this discussion is distinct from the wider demarcation debate,

all of the difficulties in defining science which arise in that discussion can be felt here. Compounding this issue is the fact that a definition of the term 'supernatural' is similarly difficult to articulate. We have discussed multiple definitions of both science and the supernatural in turn and found that in the vast majority of cases, it is impossible to coherently articulate any incompatibility at all.

This difficulty in articulating a problem is perhaps most evident in our discussion of natural law, during which even when it became apparent that we might be able to identify an instance where a supernatural phenomenon 'violated' such a law, there was no reason to think that this precluded it from scientific investigation. Similar results were seen in our discussion of scientific method and, surprisingly, even in our discussion of natural theology. Of course, this investigation has not been exhaustive, and future research may identify areas of genuine incompatibility. This is particularly evident in our discussion of multiverse theories, where we can see that much remains to be said on where exactly the bounds of science lie.

While the separationist position is therefore something that should be abandoned, even in its weaker form, this is not to say that the demarcation debate at large has no merit, nor that creationism or any other specific supernatural position belongs within the domain of science. There are many potential arguments we might give for excluding creationist ideas from science, and I only seek to argue that supernaturalism is not among them. Outlining proper demarcation criteria for science remains a potentially interesting and fruitful avenue for research.

Additionally, while there is no inherent reason to exclude the supernatural at large from science, this is not to say that there are no specific supernaturalistic claims which might fall beyond the scientific domain. This is most plausibly the case when it comes to questions of purpose or meaning, but may well extend much further. Identifying the exact relationship between science and religion is an issue which will require careful philosophical attention. I hope that this discussion has illustrated that simplistic delineation between the two is of benefit to neither.

References

Act 590 of 1981: General Acts, 73rd General Assembly, State of Arkansas. Available in *Science, Technology, & Human Values*, 7(40), 1982, pp.11-13.

Allison, H.E., 1969. 'Faith and Falsifiability', in *The Review of Metaphysics*, 22(3), pp.499-522.

American Association for the Advancement of Science, 2006. *Statement on the Teaching of Evolution*. 16 Feb. [Online] Available at: <http://archives.aaas.org/docs/resolutions.php?doc_id=443> [Accessed 12 March 2016].

Armstrong, D.M., 1978. 'Naturalism, materialism and first philosophy' in *Philosophia*, 8(2), pp.261-276.

Armstrong, D.M., 1983. *What Is a Law of Nature?* Cambridge: Cambridge University Press.

Ayer, A.J., [1936] 1952. *Language, Truth and Logic*. New York: Dover Publications.

BBC, 2006. *Britons unconvinced on evolution*. [Online] Available at: <<http://news.bbc.co.uk/1/hi/sci/tech/4648598.stm>> [Accessed 15 March 2010].

Behe, M., 1996. *Darwin's Black Box: The Biochemical Challenge to Evolution*. New York: Touchstone.

Behe, M., 2005. 'Design for Living'. *New York Times*, [Online] 7 Feb. Available at: <<http://www.nytimes.com/2005/02/07/opinion/design-for-living.html>> [Accessed 12 March 2016].

The Bible: New Revised Standard Version, 1995. Oxford; New York: Oxford University Press.

Boudry, M., 2013. 'Loki's Wager and Laudan's Error', in M. Pigliucci and M. Boudry, Eds. *Philosophy of Pseudoscience*. London: University of Chicago Press, pp.79-98.

Boyd, R., 2011. 'Scientific Realism'. *The Stanford Encyclopedia of Philosophy*. [Online] Available at: <<http://plato.stanford.edu/entries/scientific-realism/#WhaSciRea>>. [Accessed 15 March 2016].

Bushnell, H., 1958. *Nature and the Supernatural*. New York: Charles Scribner.

Calvin, J., [1536] 1960. *Institutes of the Christian Religion*. Philadelphia: Westminster Press.

Carroll, J., 2010. 'Laws of Nature'. *The Stanford Encyclopedia of Philosophy*. [Online] Available at: <<http://plato.stanford.edu/entries/laws-of-nature/>> [Accessed 26 March 2014].

Cartwright, N., 1998. 'Where Laws of Nature Come From', in P. Matthias, ed. *Nancy Cartwright: Laws, Capacities and Science. Vortrag und Kolloquium in Münster 1998*. Münster: LIT-Verlag, pp.1-30.

Cartwright, N., 1999. *The Dappled World: A Study of the Boundaries of Science*. Cambridge: Cambridge University Press.

Clarke, S., 2007. 'The Supernatural and the Miraculous', in *Sophia*, 46(3), pp.277-283.

Clarke, S., 2009. 'Naturalism, Science and the Supernatural', in *Sophia*, 48(2), pp.127-142.

Collins, F. S., 2006. *The Language of God: A Scientist Presents Evidence for Belief*. New York: Basic Books.

Corner, D., 2007. *The Philosophy of Miracles* [e-book]. London; New York: Continuum Studies in Philosophy. Available at Google Books: <<https://books.google.co.uk/books?id=31B7TCJhf5wC>> [Accessed 13 March 2016].

Craig, W.L., [1984] 2008. *Reasonable Faith: Christian Faith and Apologetics*. Wheaton, Illinois: Crossway Books.

Craig, W.L., 2001. *God, Time and Eternity*. The Netherlands: Kluwer Academic Publishers.

Craig, W.L., and Sinclair, J.D., 2009. 'The *kalam* cosmological argument', in W.L. Craig and J. Moreland, Eds. *The Blackwell Companion to Natural Theology*. Oxford: Blackwell Publishing Ltd, pp.101-201.

Craig, W.L., 2011. *Witness of the Holy Spirit and Defeasibility of Christian Belief*. [Online] Available at: <<http://www.reasonablefaith.org/witness-of-the-holy-spirit-and-defeasibility-of-christian-belief#ixzz3PNnJcJTL>> [Accessed 20 January 2015].

Davies, L., 2014. 'Pope Francis: evolution and creation both right'. *The Guardian* [Online], 29 October. Available at: <<http://www.theguardian.com/world/2014/oct/28/pope-says-evolution-and-creation-both-right>> [Accessed 12 March 2016].

Davis, P., and Kenyon, D. H., [1983] 2004. *Of Pandas and People*, 2nd edition. Texas: Houghton Pub Co.

- Davies, P., 2003. 'A brief history of the universe'. *The New York Times* [Online], 12 April. Available at: <<http://www.nytimes.com/2003/04/12/opinion/a-brief-history-of-the-multiverse.html>> [Accessed 12 March 2016].
- Dawkins, R., 2006. *The God Delusion*. London: Bantam Press.
- Devitt, M., 2008. 'Realism/Anti-Realism', in S. Psillos and M. Curd, Eds. *The Routledge Companion to Philosophy of Science*. New York: Routledge, pp.224-235.
- Devlin, H., and Gledhill, R., 2010. 'Hawking: Archbishop leads religious response'. *The Times* [Online], 3 September. Available at: <<http://www.thetimes.co.uk/tto/science/physics/article2712324.ece>> [Accessed 11 March 2016].
- Dorman, C., 1996. *McLean v. Arkansas Board of Education*. [Online] Available at: <<http://www.talkorigins.org/faqs/mclean-v-arkansas.html>> [Accessed 16 March 2010].
- Draper, P., 1989. 'Pain and Pleasure: An Evidential Problem for Theists' in *Noûs*, 23(3), pp.331-350.
- Draper, P., 1997. 'A Critique of the *Kalam* Cosmological Argument', in L. Pojman and M. Rea, Eds. 2012. *Philosophy of Religion: An Anthology*. Wadsworth: Cengage Learning, pp.172-177.
- Draper, P., 2005. 'God, Science, and Naturalism', in W. Wainwright, ed. *The Oxford Handbook of Philosophy of Religion*. Oxford: Oxford University Press, pp.271-275.
- Draper, P., 2007. *Natural Selection and the Problem of Evil*. [Online] Available at: <http://infidels.org/library/modern/paul_draper/evil.html> [Accessed 6 January 2015].
- Dretske, F.I., 1977. 'Laws of Nature', in *Philosophy of Science*, 44(2), pp.248-268.
- Duhem, P., [1906] 1991. *The Aim and Structure of Physical Theory*. Translated from French by J. Vuillemin, 1991, Princeton, New Jersey: Princeton University Press.
- Dupré, J., 2001. *Human Nature and the Limits of Science*. New York, Oxford University Press.
- Edwards v. Aguillard*, 1986. 'Amicus Curiae Brief of 72 Nobel Laureates, 17 State Academies of Science, and 7 Other Scientific Organizations, in Support of Appellees'. [Online] Available at: <<http://www.talkorigins.org/faqs/edwards-v-aguillard/amicus1.html>> [Accessed 17 February 2016].
- Ellis, G.F.R., 2008. 'Opposing the Multiverse?', in *Astronomy and Geophysics*, 49(2), pp.2.33-2.35.

Epperson v. Arkansas (1968) 393 U.S. 97.

Fair, K., 1986. *Edwards vs. Aguillard: U.S. Supreme Court Decision*. [Online] Available at: <<http://www.talkorigins.org/faqs/edwards-v-aguillard/amicus1.html>> [Accessed 10 February 2012].

Fales, E., 2013. 'Is a Science of the Supernatural Possible?', in M. Pigliucci and M. Boudry, Eds. *Philosophy of Pseudoscience*. London: University of Chicago Press, pp.247-262.

Ferngren, G.B., 2002. *Science and Religion: A Historical Introduction*. Baltimore: John Hopkins University Press.

Ferrar, A., 1966. *A Science of God?* London: Geoffrey Bles.

Feyerabend, P., 1975. *Against Method*. London: New Left Books.

Feyerabend, P., 1978. *Science in a Free Society*. London: New Left Books.

Feyerabend, P., 1981. *Realism, Rationalism and Method: Philosophical Papers Volume I*. Cambridge: Cambridge University Press.

Fishman, Y.I., 2007. 'Can Science Test Supernatural Worldviews?', in *Science and Education*, 2009, 18(6), pp.813-837.

FitzPatrick, W., 2008. 'Morality and Evolutionary Biology'. *The Stanford Encyclopedia of Philosophy*. [Online] Available at: <<http://plato.stanford.edu/entries/morality-biology/>> [Accessed 24 December 2013].

Flew, A. et al., 1955. 'Theology and Falsification: From the University Discussion', in A. Flew and A. MacIntyre, Eds. *New Essays in Philosophical Theology*. New York: Macmillan, pp.96-108.

Forrest, P., 1996. *God Without the Supernatural: A Defence of Scientific Theism*. New York: Cornell University Press.

Foster, J., 2001. 'Regularities, laws of nature, and the existence of God', in *Proceedings of the Aristotelian Society*, 101(1), pp.145-161.

Galilei, G., [1623] 1990. 'The Assayer', in *Discoveries and Opinions of Galileo*. Translated from Italian by Stillman Drake. New York: Anchor Books.

Gao, G., 2015. *How do Americans stand out from the rest of the world?* [Online] Available at: <<http://www.pewresearch.org/fact-tank/2015/03/12/how-do-americans-stand-out-from-the-rest-of-the-world/>> [Accessed 19 February 2016].

Gilkey, L.B., 1961. 'Cosmology, Ontology, and the Travail of Biblical Language', in *The Journal of Religion*, 41(3), pp.194-205.

Gillette, P.R., 2002. 'Theology Of, By, & For Religious Naturalism', in *Journal of Liberal Religion*, 6(1). [Online] Available at: <<http://www.meadville.edu/uploads/files/115.pdf>> [Accessed 13 March 2016].

Godfrey-Smith, P., 2003. *Theory and Reality*. Chicago: The University of Chicago Press.

Goodman, N., 1947. 'The Problem of Counterfactual Conditionals', in *The Journal of Philosophy*, 44(5), pp.113-128.

Gould, S.J., 1983. *Hen's Teeth and Horse's Toes*. New York; London: W.W. Norton & Company.

Gould, S.J., 1997. 'Nonoverlapping Magisteria', in *Natural History*, 106, pp.16-22.

Hansson, S.O., 2008. 'Science and Pseudo-science'. *The Stanford Encyclopedia of Philosophy*. [Online] Available at: <<http://plato.stanford.edu/entries/pseudo-science/>> [Accessed 15 March 2010].

Hansson, S.O., 2013. 'Defining pseudoscience and science', in M. Pigliucci and M. Boudry, Eds. *Philosophy of Pseudoscience*. London: University of Chicago Press, pp.61-77.

Harvey, J.C., 2007. 'The Role of the Physician in Certifying Miracles in the Canonization Process of the Catholic Church III', in *Southern Medical Journal*, 100(12), pp.1255-1258.

Hawking, S.W., and Mlodinow, L., 2010. *The Grand Design*. Great Britain: Bantam Press.

Hempel, C.G., 1945. 'Studies in the Logic of Confirmation', in *Mind*, 54(213), pp.1-26.

Hempel, C.G., and Oppenheim, P., 1948. 'Studies in the Logic of Explanation', in *Philosophy of Science*, 15(2), pp.135-175.

Hick, J., [1957] 1988. *Faith and Knowledge*. Basingstoke; London: Macmillan.

Hick, J., [1966] 2010. *Evil and the God of Love*. New York: Palgrave Macmillan.

House Bill No. 185, 1925. Public Acts of the State of Tennessee. [Online] Available at: <<http://www.law.umkc.edu/faculty/projects/ftrials/scopes/tennstat.htm>> [Accessed 16 March 2010].

- Hoyningen-Huene, P., 2008. 'Systematicity: The Nature of Science', in *Philosophia* 36(2). pp.167-180.
- Hume, D., [1739] 2003. *A Treatise of Human Nature*. New York: Dover Publications.
- Hume, D., [1777] 2004. *An Enquiry Concerning Human Understanding*. New York: Dover Publications.
- Hume, D., [1779] 1993. 'Dialogues Concerning Natural Religion', reprinted in *David Hume: Dialogues and Natural History of Religion*, 1993. New York: Oxford University Press.
- Jacobellis v. Ohio*, 1964. 378 U.S. 184, 173 Ohio St. 22, 179 N.E.2d 777. [Online] Available at: <<https://www.law.cornell.edu/supremecourt/text/378/184>> [Accessed 11 March 2016].
- Kierkegaard, S., [1846] 2009. *Concluding Unscientific Postscript*, translated by Alastair Hannay. Cambridge University Press: Cambridge.
- Kitzmiller v. Dover Area School District*, 2005a. Case No. 04cv2688. [Online] Available at: <http://www.talkorigins.org/faqs/dover/kitzmiller_v_dover_decision.html> [Accessed 10 February 2012].
- Kitzmiller v. Dover Area School District*, 2005b. 'Trial transcript: Day 3 (September 28), AM Session, Part 2'. [Online] Available at: <<http://www.talkorigins.org/faqs/dover/day3am2.html>> [Accessed 19 February 2016].
- Kragh, H., 2009. 'Contemporary History of Cosmology and the Controversy over the Multiverse', in *Annals of Science*, 66(4), pp.529-551.
- Kuhn, T.S., 1962. *Structure of Scientific Revolutions*. United States of America: University of Chicago.
- Kuhn, T.S., 1974. 'Logic of Discovery or Psychology of Research?', in A. Schilpp, ed. *The Philosophy of Karl Popper (The Library of Living Philosophers, Volume XIV)*. La Salle: Open Court, pp.798-819.
- Kuhn, T.S., 1977. 'Objectivity, Value Judgment, and Theory Choice', in his *The Essential Tension*. Chicago: University of Chicago Press, pp.320-339.
- Ladyman, J., 2013. 'Toward a Demarcation of Science from Pseudoscience', in *Philosophy of Pseudoscience*. M. Pigliucci and M. Boudry, Eds. London: University of Chicago Press, pp.45-59.
- Lakatos, I., 1969. 'Criticism and the Methodology of Scientific Research Programmes', in *Proceedings of the Aristotelian Society*, Vol. 69(1), pp.149-186.

- Lakatos, I., 1973. 'Science and Pseudoscience', in M. Curd and J.A. Cover, Eds. 1998. *Philosophy of Science*. New York; London: W.W. Norton and Company, pp.20-26.
- Lakatos, I., 1976. *Proofs and Refutations*. Cambridge: Cambridge University Press.
- Lakatos, I., 1978. *The Methodology of Scientific Research Programmes: Philosophical Papers Volume I*. Cambridge: Cambridge University Press.
- Larson, E.J., 1997. *Summer for the gods: The Scopes Trial and America's Continuing Debate Over Science and Religion*. New York: Basic Books.
- Laudan, L., 1982. 'Science at the Bar – Causes for Concern', in *Science, Technology and Human Values*, 7(41), pp.16-19.
- Laudan, L., 1983. 'The demise of the demarcation problem', in R.S. Cohan and L. Laudan, Eds. *Physics, Philosophy, and Psychoanalysis*. Dordrecht: Reidel, pp.111-127.
- Lennox, J.C., 2007. *God's Undertaker: Has Science Buried God?* Oxford: Lion Books.
- Lewis, D., 1973. *Counterfactuals*. Cambridge, Massachusetts: Harvard University Press.
- Lewis, D., 1994. 'Humean Supervenience Debugged', in *Mind* 103(412), pp.473-490.
- Loewer, B., 1996. 'Humean Supervenience', in *Philosophical Topics*, 24(1), pp.101-126.
- Lowe, E.J., 1987. 'Miracles and Laws of Nature', in *Religious Studies*, 23(2), pp.263-278.
- Macquarrie, J., 1977. *Principles of Sacred Theology*. New York: Charles Scribner's Sons.
- Mahner, M., 2013. 'Science and Pseudoscience', in M. Pigliucci and M. Boudry, Eds. *Philosophy of Pseudoscience*. London: University of Chicago Press, pp.29-43.
- Martin, M., 2002. *Justifying Methodological Naturalism*. [Online] Available at: <http://www.infidels.org/library/modern/michael_martin/naturalism.html> [Accessed 4 March 2013].
- Maxwell, G., 1963, 'The Ontological Status of Theoretical Entities', in M. Curd and J.A. Cover, Eds. 1998. *Philosophy of Science*. New York; London: W.W. Norton & Company, pp.1052-1063.
- McGrath, A., and McGrath, J.C., 2007. *The Dawkins Delusion*. Great Britain: SCPK publishing.

Mirsky, S., 2008. *Never You Mine: Ben Stein's Selective Quoting of Darwin*, 60 Second Science. [Podcast] 18 Apr. Available at: <<http://www.scientificamerican.com/podcast/episode.cfm?id=61D30BEB-A65E-7583-BB264FABBD4CD879>> [Accessed 17 March 2010].

Molnar, G., 1969. 'Kneale's Argument Revisited', in *The Philosophical Review*, 78(1), pp.78-89.

Monroe, K.R., 2012. *Science, Ethics and Politics: Conversations and Investigations*. Oxford; New York: Routledge.

Moore, R., 1998a. 'Creationism in the United States I. Banning Evolution from the Classroom', in *The American Biology Teacher*, 60(7), pp.486-498; 500-502; 504-507.

Moore, R., 1998b. 'Creationism in the United States II. The Aftermath of the Scopes Trial', in *The American Biology Teacher*, 60(8), pp.568-577.

Moore, R., 1998c. 'Creationism in the United States III. The Ban on the Teaching of Evolution Reaches the U.S. Supreme Court.', in *The American Biology Teacher*, 60(9), pp.650-661.

Moore, R., 1999a. 'Creationism in the United States IV. The Aftermath of Epperson v. Arkansas', in *The American Biology Teacher*, 61(1), pp.10-16.

Moore, R., 1999b. 'Creationism in the United States V. The McLean Decision Destroys the Credibility of "Creation Science"', in *The American Biology Teacher*, 61(2), pp.92-101.

Moore, R., 2002. *Evolution in the Courtroom: A Reference Guide*. Santa Barbara, California; Denver, Colorado; Oxford: ABC CLIO.

National Academy of Sciences, 1998. *Teaching about Evolution and the Nature of Science, Appendix C*. USA: National Academies Press.

Newport, F., 2008. *Republicans, Democrats Differ on Creationism*. [Online] Available at: <http://www.gallup.com/poll/108226/Republicans-Democrats-Differ-Creationism.aspx?g_source=position5&g_medium=related&g_campaign=tiles> [Accessed 17 February 2016].

Newport, F., 2014. *In U.S., 42% Believe Creationist View of Human Origins*. [Online] Available at: <<http://www.gallup.com/poll/170822/believe-creationist-view-human-origins.aspx>> [Accessed 17 February 2016].

Newton, I., and Machin, J., 1723. *The Mathematical Principles of Natural Philosophy* Vol. 1. Translated from Latin by Andrew Motte, 1729. London: Benjamin Motte.

Noakes, R., 2004. 'Spiritualism, science and the supernatural in mid-Victorian Britain', in N. Brown, C. Burdett and P. Thurschwell, Eds. *The Victorian Supernatural*. Cambridge: Cambridge University Press.

Noddings, N., 2003. 'Evil and Ethical Terror', in C. Taliaferro and P. Griffiths, Eds. *Philosophy of Religion: An Anthology*. Padstow, Cornwall: Blackwell Publishing Ltd.
Nola, R., and Sankey, H., 2007. *Theories of Scientific Method*. Ithaca: McGill-Queen's University Press.

Newton-Smith, W.H., 2000. *A Companion to the Philosophy of Science*. Oxford: Blackwell Publishers Ltd.

Orenstein, A., 2002. *W.V.O. Quine*. New York; Abingdon: Routledge.

Paley, W.D., 1802. *Natural Theology, or, evidences of the existence and attributes of the deity collected from the appearances of nature*. Boston: Gould, Kendall and Lincoln.

Papineau, D., 2007. 'Naturalism'. *The Stanford Encyclopedia of Philosophy*. [Online] Available at: <<http://plato.stanford.edu/entries/naturalism/>> [Accessed 22 August 2010].

Pennock, R.T., 1996. 'Naturalism, Evidence and Creationism: The Case of Phillip Johnson', in *Biology and Philosophy*, 11(4), pp.543-559.

Pennock, R.T., 1999. *Tower of Babel: The Evidence against the New Creationism*. Cambridge, MA: MIT Press.

Pennock, R.T., 2006. 'Kitzmiller v. Dover Area School District Expert Report', in R.T. Pennock and M. Ruse, Eds. 2009. *But is it science?* New York: Prometheus Books, pp.456-484.

Pennock, R.T., 2009. 'Can't philosophers tell the difference between science and religion? Demarcation revisited', in R.T. Pennock and M. Ruse, Eds. 2009. *But is it science?* New York: Prometheus Books, pp.536-577.

Pigliucci, M., 1998. 'A case against god: science and falsifiability question in theology', in *Skeptic*, 6(2), pp.66-73.

Pigliucci, M., 2013. 'The Demarcation Problem', in M. Pigliucci and M. Boudry, Eds. *Philosophy of Pseudoscience*. London: University of Chicago Press, pp.9-28.

Plantinga, A., 1978. *The Nature of Necessity*. Oxford: Oxford University Press.

Plantinga, A., [1983] 2000. 'Religious belief as 'properly basic'', in B. Davies, ed. 2000. *Philosophy of Religion: A guide and anthology*. Oxford: Oxford University Press, pp.42-94.

Plantinga, A., 1993. *Warrant and Proper Function*. Oxford: Oxford University Press.

Plantinga, A., 1997. 'Methodological Naturalism?', in *Perspectives on Science and Christian Faith*, 49, pp.134-154.

Plantinga, A., 2006. 'Whether ID is science isn't semantics'. *Science and Theology News*, [Online] 7 March. Available at: <<http://www.discovery.org/a/3331>> [Accessed 18 March 2010].

Plantinga, A., 2010. 'Naturalism, Theism, Obligation and Supervenience', in *Faith and Philosophy*, 27(3), pp.247-272.

Plantinga, A., 2011. *Where the Conflict Really Lies*. Oxford: Oxford University Press.

Popper, K., [1935] 2002. *The Logic of Scientific Discovery*. London; New York: Routledge.

Putnam, H., 1975. *Mathematics, Matter and Method: Philosophical Papers Volume I*. London: Cambridge University Press.

Ramati, A., 2001. 'The hidden truth of creation: Newton's method of fluxions', in *The British Journal for the History of Science*, 34(4), pp.417-438.

Ramsey, F., 1928. 'Universals of Law and Fact', in D.H. Mellor, ed. 1990, *Foundations: Essays in Philosophy, Logic, Mathematics and Economics*. London: Routledge and Kegan Paul, pp.140-144.

Randerson, J., 2008. 'Would you Adam and Eve it? Quarter of science teachers would teach creationism'. *The Guardian*, [Online] 23 December. Available at: <<https://www.theguardian.com/science/2008/dec/23/science-evolution-creationism-education>> [Accessed 14 March 2016].

Rowe, W., 1979. 'The problem of evil and some varieties of atheism', in *American Philosophical Quarterly*, 16(4), pp.335-341.

Rowe, W., 1991. 'Ruminations about Evil', in *Philosophical Perspectives*, 5, pp.69-88.

Rundle, B., 2004. *Why There is Something Rather Than Nothing*. New York: Clarendon Press.

Ruse, M., 1982a. 'Creation Science Is Not Science', in *Science, Technology and Human Values*, 7(40), pp.72-78.

Ruse, M., 1982b. *Darwinism Defended: A guide to the Evolution Controversies*. Massachusetts: Addison-Wesley Publishing Company.

Ruse, M., 2009. *Why I Think the New Atheists are a Bloody Disaster*. [Online] Available at: <<http://biologos.org/blogs/archive/why-i-think-the-new-atheists-are-a-bloody-disaster>> [Accessed 19 February 2016].

Ruse, M., 2011. 'Making room for faith in an age of science: a response to David Wisdo', in *Zygon*, 46(3), pp.655-72.

Ruse, M., 2014. 'Creationism'. *The Stanford Encyclopedia of Philosophy*. [Online] Available at: <<http://plato.stanford.edu/entries/creationism/>> [Accessed 11 March 2016].

Russell, B., 1952. 'Is There a God?', in J. G. Slater and P. Köllner, Eds. [1943-68] 1997. *The Collected Papers of Bertrand Russell, Volume 11: Last Philosophical Testament*. London: Routledge. pp.543-48.

Sacks, J., 2011. *The Great Partnership: God, Science and the Search for Meaning*. Great Britain: Hodder and Stoughton.

Sarfati, J., 2002. *Refuting Evolution 2*. Greenforest, Arkansas: Master Books.

Scott, E.C., and Matzke, N.J., 2007. 'Biological design in science classrooms', in *Proceedings of the National Academy of Sciences of the United States of America*, 104(1), pp.8669-8676.

Schafersman, S. D., 1997. *Naturalism is an essential part of science and critical inquiry*. [Online] Available at: <<http://www.freeinquiry.com/naturalism.html>> [Accessed 22 August 2010].

Scopes, J. T., [1925] 2008. *The World's Most Famous Court Trial: Tennessee Evolution Case*, New Jersey: The Lawbook Exchange, Ltd.

Shapin, S., 1994. *A Social History of Truth: Civility and Science in Seventeenth-century England*. London: The University of Chicago Press.

Smolin, L., 1999. *The Life of the Cosmos*. New York: Oxford University Press.

Sotos, J. G., [1989] 2006. *Zebra Cards: An Aid to Obscure Diagnosis*. United States of America: Mt Vernon Book Systems.

Stenmark, M., 2007. 'Religion and Science', in C. Meister and P. Copan, Eds. *The Routledge Companion to Philosophy of Religion*. Oxon: Routledge. pp.775-785.

Susskind, L., 2006. *Cosmic Landscape String Theory And the Illusion of Intelligent Design*. New York: Hachette.

Swinburne, R., 2000. 'Miracles and laws of nature', in B. Davies, ed. *Philosophy of Religion: A guide and anthology*, pp.422-429.

The Telegraph, 2014. *The miracle that earned John Paul II his sainthood*. [Online] Available at:
<<http://www.telegraph.co.uk/news/worldnews/europe/vaticancityandhollysee/10783125/The-miracle-that-earned-John-Paul-II-his-sainthood.html>> [Accessed 16 September 2016]

Time, 1925. 'The Great Trial'. *Time*, [Online] 20 July. Available at:
<<http://content.time.com/time/magazine/article/0,9171,881569-1,00.html>> [Accessed 11 March 2016].

US Embassy, 2016. *The Constitution of the United States, Annotated*. [Online] Available at:
<<http://iipdigital.usembassy.gov/st/english/publication/2008/04/20080416204259eaifas0.7985803.html#ixzz42nr7NSFs>> [Accessed 13 March 2016].

Van Fraassen, B.C., 1980. *The Scientific Image*. Oxford: Oxford University Press.

Van Fraassen, B.C., 1989. *Laws and Symmetry*. Oxford: Oxford University Press.

Van Fraassen, B.C., 1993. 'The pragmatics of explanation', in D.-H. Ruben, ed. *Explanation*. New York: Oxford University Press, pp.275-309.

Wagner, R., and Briggs, A., 2016. *The Penultimate Curiosity: How Science Swims in the Slipstream of Ultimate Questions*. Oxford: Oxford University Press.

Ward, B., 2002. 'Humeanism without Humean supervenience', in *Philosophical Studies*, 107(3), pp.191-218.

Wells, J., 2000. *Icons of Evolution: Science or Myth?* Washington: Regnery Publishing.

Wexler, J.D., 2006-2007. 'Kitzmiller and the "Is It Science?" Question', in *First Amendment Law Review*, 5, pp.90-111.

Wildman, W., 2004. 'The Divine Action Project, 1988-2003', in *Theology and Science*, 2(1), pp.31-75.

Wolpert, L., 1992. *The Unnatural Nature of Science*. London: Faber and Faber.